COMPUTERS and AUTOMATION

COMPUTERS AND DATA PROCESSORS, AND THEIR CONSTRUCTION, APPLICATIONS, AND IMPLICATIONS, INCLUDING AUTOMATION

"Bugs" in Automation

The Moral Un-Neutrality of Science, by C. P. Snow

Automatic Machine Scheduling

MAY
1961
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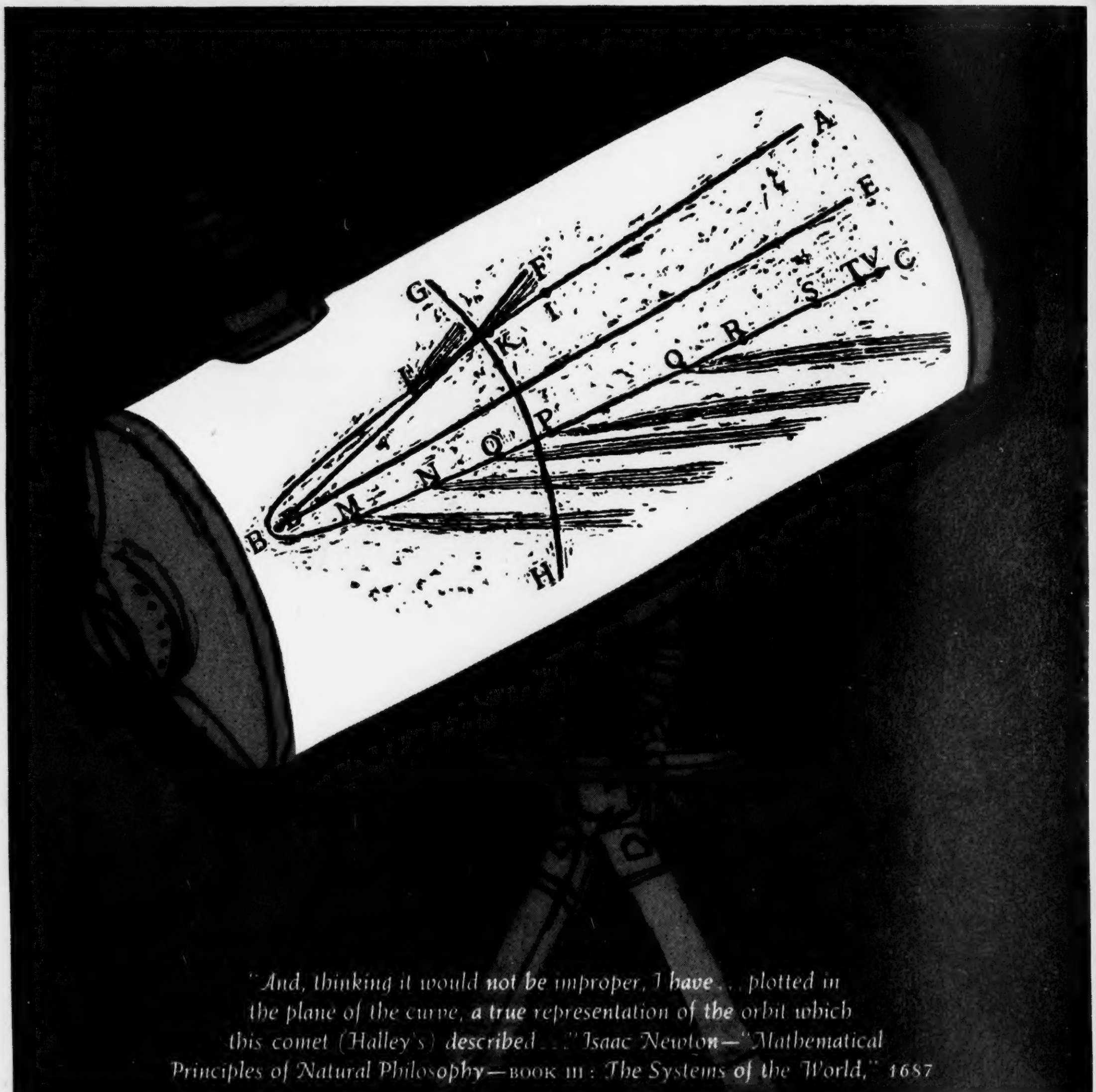
VOL. 10 - NO. 5

Scientific programmers for **S**pace **T**echnology **L**eadership



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COMPUTERS *and* AUTOMATION

COMPUTERS AND DATA PROCESSORS, AND THEIR CONSTRUCTION, APPLICATIONS, AND IMPLICATIONS, INCLUDING AUTOMATION

Volume 10
Number 5

MAY, 1961

Established
September 1951

News of Computers and Data Processors:
ACROSS THE EDITOR'S DESK

COMPUTERS and AUTOMATION is published monthly at 815 Washington St., Newtonville 60, Mass., by Berkeley Enterprises, Inc. Printed in U.S.A.

SUBSCRIPTION RATES: United States, $12.00 for 1 year, $23.00 for 2 years, including the June Directory issue; Canada, add 50c a year for postage; foreign, add $1.00 a year for postage. Address all Editorial and Subscription Mail to Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass.

ENTERED AS SECOND CLASS MATTER at the Post Office at Boston, Mass.

POSTMASTER: Please send all Forms 3579 to Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass.

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Readers' and Editor's Forum

FRONT COVER: STRETCH, THE MOST POWERFUL COMPUTER YET BUILT

The front cover shows STRETCH, the most powerful computer yet built, which was delivered in April by the Poughkeepsie Laboratories of International Business Machines Corp. to the Los Alamos Scientific Laboratory of the Atomic Energy Commission in Los Alamos, New Mexico.

The computer will be used for research and development in nuclear and thermo-nuclear energy.

The machine contains 6 magnetic core memory units which will store more than 1½ million decimal digits, with access in approximately 2 microseconds. Working with fourteen digit numbers, the machine can add in 1.5 microseconds, multiply in 2.7 microseconds, and divide in about 10 microseconds.

THE SOCIAL RESPONSIBILITIES OF COMPUTER PEOPLE

Lawrence M. Clark
Cambridge, Mass.

I.

Some time ago you printed a report from the Committee on the Social Responsibilities of Computer People of the Association for Computing Machinery. It seems to me that this report (or an up-to-date report of the committee) should be printed at least once a year in your magazine, so as to call the attention of computer people from time to time to the subject. I ask you to print it again.

II.

Report of the Committee on Social Responsibilities of Computer People to the Council of the Association for Computing Machinery, December 4, 1958.

(This report was presented to the Council of the Association for Computing Machinery informally on Dec. 4, 1958, and formally on March 4, 1959; it was accepted by action of the Council on March 4, 1959, and the Council at that time continued the committee on a stand-by basis. The report of the Committee of course in no way commits or binds the Council or the Association. The Committee on Social Responsibilities of Computer People has not subsequently presented any report to the Council, but it has arranged two sessions of papers and talks on social implications of computers at two annual meetings of the Association for Computing Machinery. The following text of the report is reprinted from the February, 1959 issue of **Computers and Automation.**)

On June 11, 1958, at the meeting of the Council of the Association at Urbana, Ill., the President was authorized to appoint a committee to consider "the social responsibilities of computer people to advance socially desirable applications of computers and to help prevent socially undesirable applications." A committee of four (the undersigned) was appointed, has held three meetings during the autumn of 1958, and hereby respectfully presents this report.

The committe considered the meaning and scope of its assignment. The committee arrived at a tentative statement and findings on the social responsibilities of computer people, which are given in Sections 1 and 2 below. The committee agreed that its assignment did not include defining or recommending an official position to be taken by the Association for Computing Machinery. The committee did agree, however, on recommending to the Council further action, which recommendation is stated in Section 3 below.

Section 1 — Introduction

One most basic fact concerning modern man is that he has his being in human society. In earlier times he was less dependent on others, and in turn the fortunes of the larger group were not so directly based on the contributions of the individual. But as man fashioned his social organization into ever higher and more complex forms, the relationship between the individual and society became closer and more interdependent. The individual no longer provides for any appreciable part of his own needs; he performs a small fraction of the total work required in the production of goods and services. Through division of labor his role has become increasingly specialized. At the same time society has become dependent on the individual to perform his indispensable part in the highly organized system of partial contributions of many people.

Along with the growth of mutual dependence, man's power has increased a thousandfold. Compare the ancient man with his bow and arrow to today's pilot carrying atom bombs. Thus the individual has acquired power to effect drastic changes in the conditions of life of many people.

There is a universal cause and effect relationship between man and society. All of us accept responsibilities for ourselves, and hence by the same principle we must assume social responsibilities—for in a profound sense the two cannot be separated.

While every human being has social responsibilities, their nature and degree vary from individual to individual. A highly trained scientist in an influential position, for example, has responsibilities different from those of a fur trapper in the north woods .

We must look at ourselves (computer people) as being in control of a tremendously powerful tool. It is necessary to understand the vital role that computers play in the affairs of men. We must comprehend something of their place in technological progress, in science and management, in automatic control and prediction. Computers are becoming an essential part of the social organism itself, particularly its communication and control system. Since computers are inextricably tied to economy and culture, we must never lose sight of their importance to the welfare of our country and mankind. When one reflects upon the great forces that we computer people are associated with, it is no longer difficult to grasp, and perhaps to accept, our heavier-than-average share of responsibility.

What might one do to discharge his computer-

connected social responsibilities? One positive thing would be to help develop socially desirable applications, such as those mentioned in Section 2 of this report. The solution of scientific problems relating to man's welfare and happiness is a wide area for the application of computers.

Section 2 — Findings

1. *Basic Social Responsibilities.* Each human being shares equally in a basic social responsibility—a duty towards society. This duty is in part enforced legally and in part assumed ethically.

2. *Special Social Responsibilities Depending upon the Individual's Role and Functions in Society.* In addition, a human being has a number of special social responsibilities determined by his various roles and functions in society—his spheres of influence, knowledge, occupations, activities, etc. Each of these carries with it a value system whether esthetic or ethical, and the variety of these value systems may engender conflicts within the individual. Each individual must face and resolve these conflicts for himself.

3. *The Social Responsibilities of Computer People.* Therefore, the individual involved in computer activities has, in addition to all his other social responsibilities, those placed upon him by his computer activities—responsibilities towards society and the parts of it: his profession, his employer, his country, mankind as a whole, etc.

a. He cannot rightly ignore these responsibilities. He should think about them.
Example: It is wrong to give no thought to the subject of his responsibilities as a computer person.

b. He cannot rightly delegate his responsibilities. Therefore, he should not accept without thinking standards of values and behavior suggested to him.
Example: It is wrong to accept orders of an employer without considering their morality. If he disagrees, he must either argue the point or resign or both.

c. He cannot rightly neglect to think about how his special role as a computer person can benefit or harm society. Therefore, he should think about how his special capacities can help to advance socially desirable applications of computers and help to prevent socially undesirable applications.
Example: It would be wrong for him to share in the application of automatic computers to the extermination of millions of people.

d. He cannot rightly avoid deciding between conflicting responsibilities. Therefore, he must think how to choose.
Example: In a conflict between the value system "the advancement of pure knowledge" and the value system "science in the service of humanity," it would be wrong for him to avoid making a decision.

4. *Socially Desirable and Socially Undesirable Applications.*

a. There are many applications of computers which are obviously socially desirable.
Examples (all of these are currently being investigated on computers):
analysis of causes and processes contributing to cancer; analysis of mental and emotional illness; solution of metropolitan traffic problems; mechanical translation of languages to aid in scientific understanding.

b. There are also some applications of computers which are obviously socially undesirable.
Example (one cited by Dr. W. J. Pickering, Head, Jet Propulsion Laboratory, Calif. Institute of Technology):
"This is the prospect we face: the decision to destroy an enemy nation—and by inference our own—will be made by a radar set, a telephone circuit, an electronic computer. It will be arrived at without the aid of human intelligence. If a human observer cries 'Stop, let me check the calculations,' he is already too late, his launching site is destroyed, and the war is lost."

c. There are some, perhaps many, applications of computers which cannot be readily classified as socially desirable or socially undesirable.

Section 3 — Recommendations

In view of the above statement, the Committee recommends that the Council of the Association for Computing Machinery that the following course of action:

a. that the Council, if it sees fit, approve releasing and publishing of this report as the report of the Committee without binding or committing the Association;

b. that the Council encourage the study and discussion in various publication media of topics related to the social responsibilities of computer people;

c. that the Council approve the establishment of forums on this subject at meetings of the Association for Computing Machinery;

d. that the Council continue this committee on a stand-by basis.

Saul Gorn, *Chairman;* Melvin A. Shader, Arvid W. Jacobson, Edmund C. Berkeley

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ARMAMENTS AND COMPUTER PEOPLE
By the Editor

1. Military Computer Work

The report that the Committee on Social Responsibilities of Computer People made two years ago has been questioned since then by some computer persons who are actively concerned with the military defense of the United States and who have participated in the design and applications of computers for military purposes. Many computer people are in fact working loyally and patriotically in military preparations for passive and active defense, in which computers play an important role. They work on armaments which will make military aggression look like a very bad idea to any rational enemy, in order to make sure that the United States will never be treated like the countries of Europe which Hitler's Nazis invaded and over-

(Please turn to Page 22)

NEWS of Computers and Data Processors

"ACROSS THE EDITOR'S DESK"

$1.5 MILLION COMPUTER FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Electronic Associates, Inc.
Long Branch, N.J.

The world's largest and most advanced general purpose analog computer; designed and built for the National Aeronautics and Space Administration, is shown in the picture undergoing final inspection and check-out at this company's plant. Developed and built under a $1,510,000 contract, all units of the computer will be installed at NASA's research center at Langley Field, Va., this spring.

The computer system will be used for analytical computation in a vast electronics calculation program for simulating future satellite and space vehicle programs. It occupies more than 1,800 square feet of floor space and comprises five separate PACE 231R computer consoles; these will be used separately or in slaved groups with a sixth unit already installed at Langley Field.

More than 1,500 high-speed computing units are provided, including 800 specially designed amplifiers. With these units, complex mathematical equations involving addition, subtraction, multiplication, division, function generation, differentiation and integration can be solved in less than a minute's time after the problem has been programmed into the computer.

Also being supplied are three Automatic Digital Input-Output Systems (ADIOS); each is able to set up any part of the system (or the whole system) from previously prepared punched paper tape or manual keyboard. Three of the five computing systems include High Speed (up to 50 solutions per second) Repetitive Operation (HSRO) with a display console. As many as eight channels of information may be compared simultaneously on the HSRO large-screen scope enabling operators to select optimum solutions in a fraction of the time required with less sophisticated systems. Units also have a dynamic memory feature which, during any continuous analytical problem, permits the recall of previous computations at any given point as a digital input or starting point of a new or related problem. Other features of the 100-foot-long computer include tape-set function generators and high-accuracy resistors, capacitors and sine-cosine function generators.

AUTOMATED TEACHING SYSTEM UNDER COMPUTER CONTROL

University of California
Los Angeles 24, Calif.

During the next two years, two researchers at this university will compare current human and machine teaching methods and try to develop a mathematical model of an automated teaching system under computer control. The research of Harry W. Case, professor of engineering and psychology, and Arnold Roe, associate engineer, will be supported by a $100,000 grant from the U.S. Office of Education and will draw on the skills of UCLA engineers, mathematicians, psychologists and educators.

In the first part of their study, the researchers plan to test some 200 students in the UCLA engineering freshman class. They will compare the rate and speed of learning while using various types of teaching machines, automated programs, textbooks, classroom setups and human instructors.

In similar controlled experiments during the past two years, Roe found that students using programmed machines or textbooks did better than students learning through standard lectures. However, this better performance depended much less on the type of machine used than on the program, the "inner works", the carefully selected and sequenced instructional material which comprises a lesson or course.

Interestingly enough, students learned faster still when listening to a "programmed" teacher, whose lessons were made up of a careful sequence of pre-tested material, than when using machines or programmed texts.

Once Case and Roe have a solid idea as to which teaching method and program works best, they plan to develop a highly sophisticated electronic teaching system, which will determine which kind of subject and parts of any subject can be taught more effectively by a human teacher or by a machine.

Their teaching system might take the form of a computer supplemented by display units and remote television, in which the computer will serve as a private tutor to each student.

Such a computer could pose questions, correct homework, pace lessons individually for each student, review earlier classwork, store a 1000-book library in its memory, and draw on the experience of the country's best teachers.

In addition, the computer program could be changed and modified continuously, as indicated by teaching experience, student performance, and new subject material.

What about the human teacher in the electronic age?

"No doubt there will always be teachers who will be intuitively better than any machine likely to be developed in the next 20 years," says Roe. "But just as we now have a small group of super-actors and performers with a national audience through the movies and television, we may well end up with a small number of super-teachers whose skill and know-how will benefit students throughout the country."

SOCIAL SECURITY INFORMATION REPORTED ON MAGNETIC TAPE

Department of Health, Education, and Welfare
Social Security Administration
Bureau of Old-Age and Survivors Insurance
Baltimore 35, Maryland

Almost 30 large companies are now shipping a single reel of magnetic tape to the social security recordkeeping headquarters every three months. These replace typewritten reports of employees' earnings, which often ran to more than 1000 pages for each employer, each calendar quarter of the year.

A growing number of firms use electronic data processing equipment to prepare their payrolls, and make their social security wage reports a by-product of regular payroll operations.

There are savings to both the companies and to the Government. The company is able to eliminate the time-consuming and expensive typing of lengthy wage reports, along with the transcription errors which are costly to correct -- both for the employer and for the Government.

The taped wage reports, prepared automatically from the employer's payroll records, also cuts steps out of the Government's processing of the reports. Savings of $50,000 a year are made for each million wage items the Social Security Administration receives on tape.

About 300 companies in the country have 10,000 or more employees each, and account for 15 percent of the national work force. If these 300 or so companies made their Employer's Quarterly Federal tax returns on magnetic tape,

savings to the trust funds out of which social security benefits are paid would total more than $500,000 a year.

Individual companies would save, too, the Social Security Administration points out, and both business and Government would benefit from the greater accuracy, speed, and smoother flow of operations that would result from the tape reporting method.

THE MARKET FOR COMPUTERS AND AUTOMATION EQUIPMENT

Roger W. Bolz
Editorial Director
Automation Magazine

The continuing trend throughout American industry to automation will mean a $6.8 billion market in 1961 for suppliers of equipment and controls.

Our latest study of the automation market for 1961 shows an estimated increase in industrywide spending of $600 million over the 1960 level. This $6.8 billion market will be shared by the two major product classifications of equipment and controls.

Spending for automated equipment will amount to an estimated $4.5 billion, apportioned among six principal sub-categories:

1. Handling Equipment -- $910 million, up $70 million from 1960's $840 million and 13.8 percent over 1959's $800 million. This category includes all engineered handling systems, conveyors, feeders, hoppers, dispensers, pallet loaders, stackers, transfers, pneumatic conveyors, elevators, loaders, etc.

2. Machine Tools -- $605 million, against $575 million in 1960, and a rise of 21.0 percent from $500 million in 1959. This covers all automatic cutting and forming machine tools as well as standard or special machines, and elements suitable for automated operations.

3. Special Machinery -- $1125 million, from $1010 million last year, and an increase of 12.5 percent from the $1000 million of 1959. This group includes all special-purpose production machinery for many areas such as heat processing, painting, cleaning, welding, molding, casting, glass working, metal-working, assembly, etc.

4. Process Machinery -- $1050 million, up $60 million from $990 million in 1960, and 16.6 percent over 1959's $900 million. Includes all machinery for altering, combining or treating materials or products produced in food, chemical, paper, pharmaceutical, mining, petroleum, and like industries.

5. Data Processors -- $575 million, against $500 million last year. This category covers equipment used in processing data for industrial enterprises and includes punch card machines, readers, coders, tape readers, print out devices, data handlers, computers, production control equipment, tape operated typewriters, programmers, etc.

6. Packaging Machinery -- $240 million instead of 1960's $210 million. All machinery for filling, bottling, wrapping, boxing, bundling, and packaging products of all kinds automatically. Includes conventional and specially designed integrated lines.

The automatic controls market in 1961 will reach an estimated $2.3 billion. This will also be shared by six major sub-categories:

1. Instrument -- $570 million, against $496 million last year, and a 32.5 percent increase over the $430 million of 1959. This category covers all basic process control instrumentation for sensing, measuring, gaging, indicating, integrating, and controlling fluids and dry products being processed continuously or in batches.

2. Electronic -- $175 million. This is a $37 million rise from 1960's $138 million and an increase of 52.1 percent over the $115 million spent in 1959. This area covers only electronic (frequency, voltage, impedance, power, electromagnetic field, waveform, etc. at other than power supply character) control devices and systems used to control production equipment, both tube and solid-state elements -- i.e., numerical controls, welding controls, magnetic amplifiers, static controls, tube rectifiers, photoelectrics, counters, closed-circuit TV, motor controls, telemeters, etc.

3. Electric -- $900 million, up $75 million from last year's $825 million and 20.0 percent over the $750 million of 1959. This grouping includes electric power, drive and control systems and components -- motors, generators, rectifiers, starters, controllers, relays, switches, electric brakes and clutches, timers, heaters, program controllers, step

switches, solenoids, counters, control panels, etc.

4. Pneumatic -- $330 million, a $30 million increase over the $300 million spent in 1960, and a rise of 20.0 percent from 1959's $275 million. Comprised of all components such as cylinders, valves, actuators, servo valves, relays, compressors, filters, lubricators, piping, and systems for air power and control of industrial equipment.

5. Hydraulic -- $270 million, up from last year's figure of $250 million, and a 20.0 percent rise over the $225 million of 1959. Includes all components needed for hydraulic power and control industrial machinery -- pumps, valves, cylinders, actuators, servo controls, relays, filters, tanks, hose, piping and systems.

6. Computers -- $50 million, against $40 million last year. This category includes only those special or adapted computers used for on-line process logging and control in chemicals, petroleum, foods, primary metals, power, etc., as well as special computing devices for control. Both digital and analog units and accessories.

ANALOG SIGNALS CONVERTED TO PULSE DURATION SIGNALS

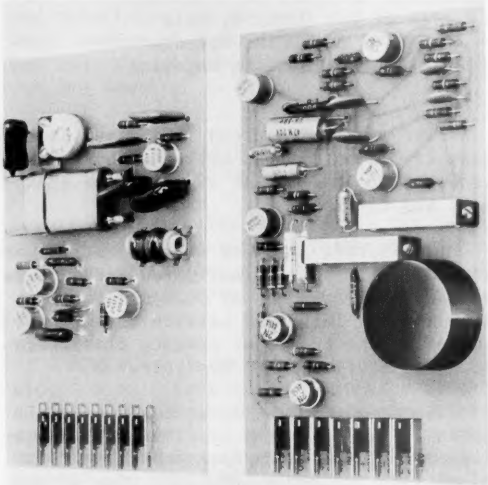
Merritt White
Genisco, Inc.
2233 Federal Ave.
Los Angeles 64, Calif.

This company has produced a solid-state analog-to-pulse-duration (APD) instrumentation system. It has applications to thermocouples, resistance thermometers, strain gage transducers, and other DC-voltage, low-impedance sensing-instrument sources.

This data sampling and processing system directly converts a low-level electrical input signal to a pulse linearly related in duration to the input-signal amplitude. The pulse duration is then digitally measured and displayed, recorded, or processed further for input to digital computing equipment. The system can be designed to operate either in a sequential or parallel data sampling mode.

The heart of the system is the solid state APD converter; it converts the interrogation pulse supplied by a solid state APD control clock. The crystal-controlled clock includes the logic for sequentially interrogating any number of converters, and can also provide logic for channel identification, system calibration, or other functions. Modular design permits building systems of several hundred channels.

The systems feature low power and space requirements: Typically, 10 watts for a 10-channel system comprising 10 APD converters, a control clock, and regulated solid-state power supply, (excluding sensing transducers and readout equipment); housed in a half cubic foot space or standard rack mounted with 7½-inch panel.



STRAIN GAGE WITH BUILT-IN COMPUTER TO SOLVE STRAIN-STRESS EQUATION

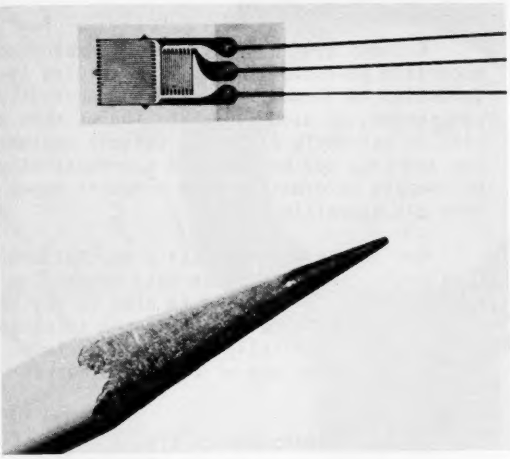
Thomas L. Gaffney
Electronics & Instrumentation Division
Baldwin-Lima-Hamilton Corp.
Waltham 54, Mass.

A new bonded resistance-foil strain gage -- with a built-in computer that solves general strain-to-stress equations automatically -- has been developed by this company.

The new gage will simplify greatly the task of obtaining stress readings in a wide range of testing and measuring applications -- by automatically eliminating the need for tedious, time-consuming calculations of stresses from the strain indications.

The new stress-strain gage (called SR-4) provides electrical responses which are proportional to either stress or strain, at the discretion of the user, by using two independent axial strain-sensing elements oriented 90 degrees apart.

One element measures the conventional strain. The other element acts as the automatic computer by rejecting the axial component of strain caused by stress in a transverse direction. The combined elements then respond only to that component of strain which is produced by stress in the axial direction.



The two sensing elements have a common electrical connection to permit independent use for measuring conventional axial or transverse strains, or combined use to measure the stress along the principal gage axis.

Through use of a simple switching arrangement, with the three-wire system provided, three measurements can be made easily and rapidly:

- Strain -- along principal sensing axis.
- Stress -- along principal sensing axis.
- Strain -- along transverse axis.

This unique versatility is provided by appropriate design of grid configuration, and a controlled resistance ratio between the two elements. The ratio depends primarily on Poisson's ratio of the material for which the gage is designed and calibrated.

SOLID-STATE IBM 1410 SYSTEM TO SIMULATE 650 COMPUTER

International Business Machines Corp.
Data Processing Division
112 East Post Road
White Plains, N.Y.

A program that will enable users of the IBM 650 computer to run 650 routines on the new, solid-state IBM 1410 system has been announced.

The 650 simulation program for the 1410 simplifies the programming transition from the 650 to the 1410. Reprogramming of some 650 routines may now be deferred until after installation of a 1410.

The simulator extends the life and usefulness of 650 program libraries. In addition, seldom-used or "one-shot" 650 routines need never be reprogrammed.

The 650 simulator will be available on a field-test basis in September of this year. The 1410 system employed in simulation must be equipped with 40,000 core storage positions, the 1402 card read punch, and comparable input/output devices to the 650.

600 AUTOMATIC CHANGERS OF $1 BILLS USING MAGNETIC AMPLIFIER CIRCUITRY

Magnetics Inc.
Butler, Pa.

A machine that converts one dollar bills into a dollar's worth of dimes, nickels, and quarters, and that uses magnetic amplifier circuitry to "sense" and validate genuine currency, was demonstrated at the I.R.E. Show in New York, March 20-23.

This company, which produces industrial control equipment, displayed the unit as part of its exhibit. The dollar bill changer is manufactured by the A.B.T. Division of Automatic Canteen Company of America.

It accepts only U.S. one dollar bills and rejects all counterfeit money, foreign currency, and bills of higher denominations.

About 600 of the machines now are installed in the U.S., primarily to serve vending machine locations by providing adequate change.

EXTENDING MAN'S INTELLECT -- THE WESTERN JOINT COMPUTER CONFERENCE

Western Joint Computer Conference Press Comm.
Ambassador Hotel
Los Angeles, Calif.

"Computer accomplishments will be of ultimately greater significance to civilization than those of space technology or nuclear physics."

This challenge was presented to more than 2,500 persons who attended the Western Joint Computer Conference May 9-11 by WJCC General Chairman Dr. Walter F. Bauer, Thompson Ramo Wooldridge Inc. The Conference was sponsored by the National Joint Computer Committee, representing the Institute of Radio Engineers, the American Institute of Electrical Engineers and the Association for Computing Machinery.

The Conference theme was "Extending Man's Intellect". Dr. Bauer stated, "It can be said that man's ultimate goal is not to explore the universe, nor to harness unlimited energy, but to build a device equal to or nearly equal to his own mental powers."

Advances in computer technology will have a beneficial effect on the economy through increased productivity, will be of prime importance in cold war strategy, and are fast becoming a symbol of international prestige, Dr. Bauer noted.

Technical phases of the Conference showed the progress currently being made, and presented some of the goals yet to be attained. Approximately 70 technical papers, by 87 authors, were discussed in 15 sessions.

A session on "Micro-System Electronics" dealt with modern techniques in designing and inter-connecting micro-scale components. Discussions on "Modeling Human Mental Processes," "Problem Solving and Learning Machines," and "Automata Theory and Neural Models" shed some light on the future extension of man's intellect by computers. Sessions on "Pattern Recognition" and "Information Retrieval" presented sophisticated techniques of growing importance. Other areas explored were "Memory Devices," "Digital Simulation," "Computers in Control," "Automatic Programming," "Large-Scale Computers," and analog computer techniques.

Among the $3 million worth of products and equipment exhibited were some significant new developments.

A thin-film memory and a "real-time" system were shown by the Remington Rand Univac Division of Sperry Rand Corporation. The thin film memory is an advanced solid-state data processing system enabling a computer to operate in billionths of a second rather than millionths. The "real-time" system computes simultaneously with the event being recorded, as in controlling and altering the trajectory of a missile in flight.

General Dynamics/Electronics exhibited a microfilm printer, capable of recording information on 35-mm film at 15,000 characters per second. A unique application of this device is automatic drafting, whereby engineering drawings can be produced electronically by feeding information from computer tapes into the microfilm printer.

New in the low-cost field was National Cash Register's electronic data processing system, which is variable in size to fit the application. Peripheral units can interrupt a program automatically to obtain maximum efficiency in the use of input and output units.

These and many others from a total of 55 firms were displayed in 103 booths.

Speakers at the Conference were Thomas Watson, Jr., president of IBM, who delivered the keynote address Tuesday, May 9; Dr. Morris Rubinoff, chairman, National Joint Computer Committee; and Dr. Simon Ramo, executive vice-president, Thompson Ramo Wooldridge Inc., who addressed the Wednesday, May 10, luncheon.

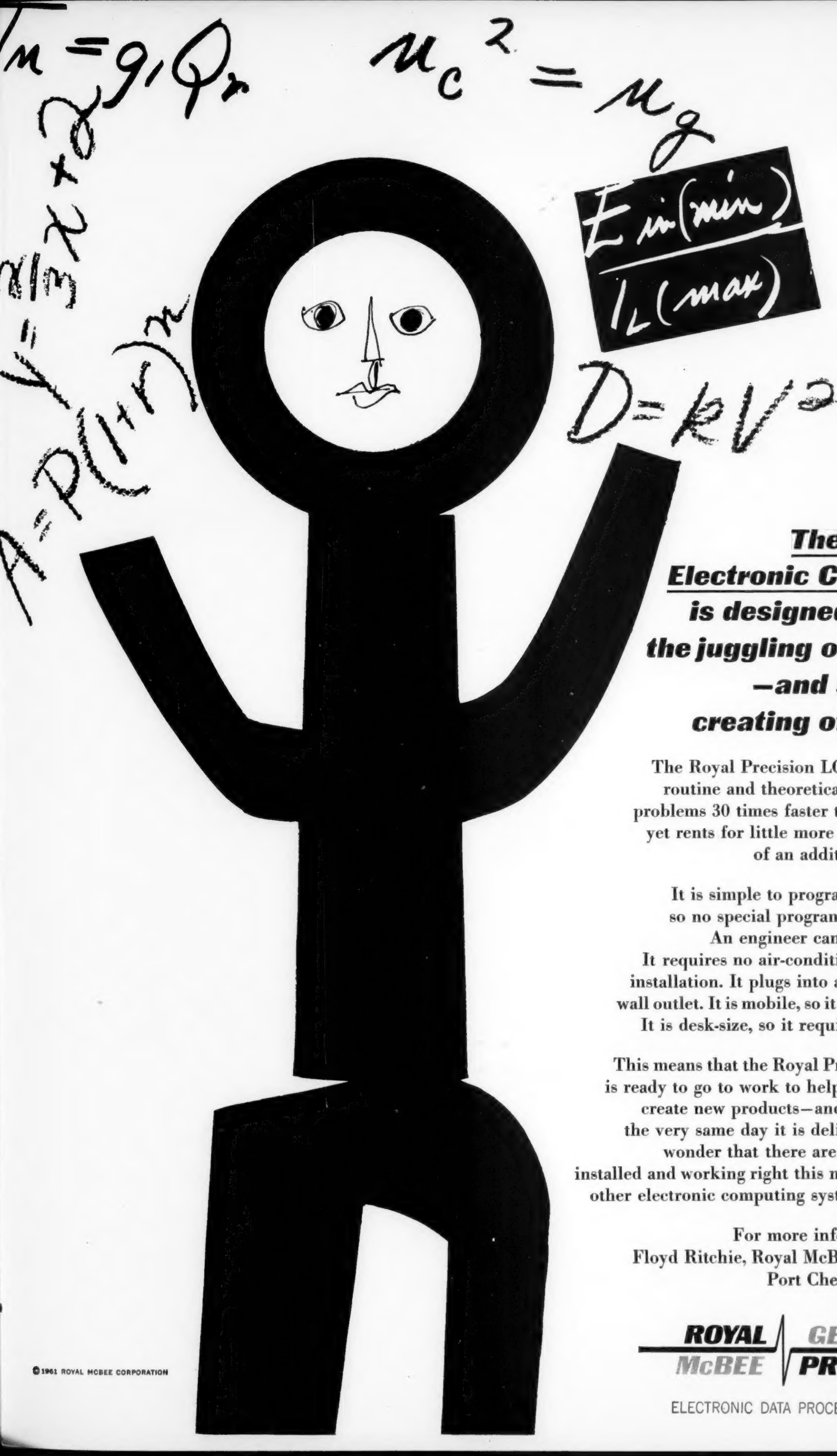
NEW COMPUTER DEPARTMENT DEALING WITH INDUSTRIAL PROCESS CONTROL SYSTEMS

Minneapolis Honeywell Regulator Co.
Special Systems Division
Pottstown, Pa.

A separate computer department in the Special Systems division of Minneapolis-Honeywell Regulator Company has been established.

The new department will be responsible for engineering and marketing integrated industrial process control systems incorporating the Honeywell 290 digital computer.

An important responsibility of the new computer unit will be the organization of project teams to carry out applications from initial concept to installation. It also will coordinate activities with the company's Electronic Data Processing Division, Industrial Products Group, and other divisions in the design of products for control systems.



$u_c^2 = u_g$
$\frac{E_{in}(min)}{I_L(max)}$
$D=kV^2$
$A=P(1+r)^n$

"BUGS" IN AUTOMATION

Some Firms Complain of Excessive Costs, Frequent Breakdowns —Postal Machines Fooled by Trading Stamps—Jantzen to Replace Big Computer—Wheelbarrow Bests a "Brain"

Stewart Toy

Staff Reporter
Wall Street Journal
New York 4, N. Y.

(Reprinted with permission from *The Wall Street Journal*, Dec. 27, 1960, published by Dow Jones & Co., Inc., New York 4, N. Y.)

At the sprawling U. S. Naval Supply Center in Norfolk, Va., the top brass recently gave their underlings a disturbing order: Get rid of a giant electronic computer system which for seven months had filled orders for the 600,000 nautical items the depot handles.

The decision came after the center had paid out nearly $1 million in rental, installation and engineering fees for the Burroughs Corp. Model 220 computer and related electronic equipment. Says Rear Adm. Hugh C. Haynsworth, commander of the Norfolk complex: "We might as well face it—the system was a failure."

The 220's "discharge" is not, of course, typical of experiences either with this machine or with other forms of so-called automation. For many companies, automation is providing impressive savings and sharp increases in efficiency. But the Navy's experience does indicate the promise of labor-saving devices isn't always what it seems, even in this age of sophisticated circuitry and masterful machines.

Many businessmen report they're encountering a variety of headaches in their efforts to increase plant efficiency by hooking up computers and other complex gear to their production and clerical processes. A few firms are even abandoning new-fangled equipment in favor of more mundane machinery, while others are adopting an increasingly skeptical attitude toward the new automation devices.

Common Complaints

Among the common company complaints: Equipment and installation costs often run higher than expected; computer manufacturers sometimes oversell the blessings of their products; equipment complexity causes frequent and expensive breakdowns; and the new apparatus in some cases may turn out to be altogether too elaborate for the job it has to do, thus making the required investment unnecessarily large.

These complaints, of course, add up to a paradox: Automation may cost the customer more than it saves.

Next August, for instance, Jantzen, Inc., a Portland, Ore., manufacturer of sportswear and swimming suits, will yank out a big computer that for nearly two years has translated orders for Jantzen apparel into

> *"Let me listen to those who disagree with me—I can learn from them—my friends who say only what I already believe do not instruct me."*
> — B. A. Weissman

cloth requirements. "It's just too expensive for what we're getting out of it," states Kenneth C. Smith, Jantzen's vice president and treasurer. Mr. Smith says he has found it increasingly difficult to justify the $180,000-a-year rental fee the company pays for the computer and its accessory gadgets.

Although Jantzen says it still believes in computers —the company plans to replace the big computer with a lower-I.Q. brain which it figures will do the same job for $80,000 a year less—one of its competitors has become more permanently soured on electronic wonders in general.

Computer Discarded

More than a year ago, White Stag Manufacturing Co., another Portland sportswear concern, threw out a big computer it had used for billing and general accounting. The company is now using a standard calculating system, which it says does the work faster than the big computer and saves $46,000 a year in rental costs.

Even in the chemical and petroleum industries, where the virtues of automation have been clarioned the loudest, there are signs that all is not going smoothly.

At a Texaco, Inc., high octane gasoline refinery in Port Arthur, Tex., a Thompson Ramo Wooldridge computer has been running the entire operation for some 18 months. The facility has been widely heralded as the first completely automated industrial plant in the world. For "competitive reasons," Texaco refuses to release performance or cost figures on the computer installation, but specialists in the field figure it cost the company about $400,000.

Oil industry engineers are generally agreed Texaco's glamorous operation is not working out nearly as well as the company had expected. Says a high official of a major refinery construction firm: "The computer is working fine, but there's no economic advantage

to it. In fact, I'm sure they're losing money on it." He adds: "It's pretty certain Texaco won't use computers to run any more refineries."

Texaco won't comment on such assertions. Henry Flynn, general manager of Texaco's refining department, states only that the success of the Port Arthur installation "is something you can't determine overnight. It will take us three or four years to know whether it's economical or not," he says. "It's still pretty much in the experimental stage."

"Caused Disenchantment"

Texaco's seeming lack of enthusiasm about its pioneering venture bothers some makers of automation equipment. "It's caused a lot of disenchantment among potential oil industry customers," says an official of Beckman Instruments, Inc., a Fullerton, Calif., electronics concern.

One apparent reason for disappointment in some computer installations is what the president of one big electronics concern calls "over-engineering." Companies tend to become fascinated, he says, with the prospect of whirring computers and "space-age" gadgets running what may be a simple and already efficient operation.

Comments George Steele, an independent computer designer: "Using automation gives a company considerable prestige and advertising values; it marks them as 'progressive.' The company's engineers can give learned papers at technical conferences. And even if the installation fails, they just write it off as a research project."

In 1956 McCulloch Corp. of Los Angeles began drawing up plans for a spectacular new die-casting plant to make parts for the company's Scott outboard motor. "Management wanted the finest fully-automated die-casting plant in the country," recalls Bob Astle, then McCulloch's chief industrial engineer and now manager of manufacturing and engineering at Rohr Aircraft Corp.'s plant in Riverside, Calif.

How to Remove Scrap?

Mr. Astle was given the job of touring the country to find the ultimate in automation. He says the knottiest problem he encountered was devising an automatic conveyor system for carting off metal scrap from the die-casting machines. "It was possible to do it," he says, "but it would have cost $180,000 and would never be paid off. It took several months to convince executives they didn't need it. They were just intrigued with the word automation." Bill Goudson, McCulloch's senior industrial engineer, replies that the company was "intrigued, but only by the possibility of saving money."

Final solution to McCulloch's scrap disposal problem: One man with a wheelbarrow.

Bud Semco, a Los Angeles consulting engineer who asserts "There's a lot to be said for the horse and buggy," tells this anecdote about a businessman who needed to transport paperwork from one story of a building to another floor. "He thought about installing a $1,500 pneumatic tube system," Mr. Semco says, "but he finally just cut a hole in the floor and put in a wire pulley, for a total cost of $7."

Manufacturers of automation equipment contend many difficulties could be avoided if their customers would take the necessary pains to study their operations in depth.

"Most companies don't realize the immense effort it takes to program a computer for control of an industrial process," says E. A. Holmes, III, a vice president of North American Aviation, Inc.'s, Autonetics division, a digital computer maker. "A lot of people have stubbed their toes because of inadequate research. They misapply a computer, have negative results, and then sour on them."

In 1957 Sun Oil Co. hired Litton Industries, Inc., to study one of the firm's butane-making facilities at Marcus Hook, Pa., with a view to running it by computer. The aim was not to increase production, but to squeeze the maximum profit from the operation by more efficient control of the plant's two important variables, the flow of steam and raw materials.

Formula Fumble

The initial problem in this, as in all applications of computer control, was to define the process in terms of mathematical equations, the only terms understandable to a computer. A Litton research computer was to solve these equations and feed the solution to another electronic brain, which then would be able to operate the plant. But the equations Sun Oil had developed over the years to describe the butane-making process overlooked a number of minor variables which can loom large in an automated plant. Eric Weiss, chairman of Sun's computer committee, concedes Sun's programming formula failed to account for such possible happenings as valve breakdowns and steam shortages.

Officials of Sun Oil and Litton disagree about whether blame for the automation project's problems should be attributed to "over-simplification" in programming the computer or to the capability and functioning of the computer itself. In any case, after a year and a half of troubles and more than $50,000 in expenses, Sun Oil abandoned the project.

L. Peter Retzinger, director of Litton's computer systems laboratory still believes the butane plant could profit from computer control. "But it would take us another 18 months of study before they'd be ready to install it," he says, "and the company's just not interested any more."

Careful study, of course, is no guarantee automation efforts will pay off; even the most painstakingly-planned projects occasionally backfire. In the case of the Navy's automation troubles at Norfolk, Naval technicians and Burroughs engineers spent more than two years analyzing the supply center's order-processing needs and designing a system to fit them.

System's Capabilities

The Norfolk depot, is the main supply center for all ships in the Navy's Atlantic, Mediterranean, Caribbean and Antarctic fleets. Its clerks sell between 15,000 and 25,000 items every day to ships' purchasing officers. The computer system, engineers decided, should be able to handle at least 22,000 transactions daily. The system that finally was installed could, under ideal conditions, process 3,666 sales an hour—

providing a comfortable margin of 7,328 transactions above the requirements, based on an eight-hour-day operation.

Then where did the system go awry? "First of all," says Adm. Haynsworth, "we couldn't use the computer more than four hours a day. The serial numbers and the prices of items we stocked were changing daily, so we had to spend several hours reprogramming the computer. Furthermore, the computer kept breaking down. If it spent a whole day out of commission, we'd be left with a backlog of 20,000 orders. We just couldn't afford as many failures as we had, with ships arriving all the time to get supplies."

Donald Young, assistant to the president of Burroughs, insists the 220's mechanical failures were "normal breakdowns." He contends all computer installations "have such breakdowns at first. This was an experiment," he says, and "I'm sure we could still make it work if we had more time."

Automation's Accomplishments

To be sure, automation has chalked up some impressive feats. Electronic data processing techniques are cutting bookkeeping chores to a minimum for an increasing number of firms. Computers are showing a particular talent for running electric power generating plants. Reasons: The power-making process is well understood; a small increase in efficiency will generally justify a big capital expenditure; and the plants have long been controlled by electronic devices that are easily adapted to further control by the big brains.

But even where automation has proved it can cut costs or raise product quality, companies report a number of discouraging problems.

The Los Angeles division of North American Aviation, uses eight automatic metal-cutting machines, run by magnetic tape, to hew out parts for the B-70 supersonic bomber. The tape, in turn, is directed by a computer. Although the new machines make the parts more cheaply than the hand-operated models previously used, maintenance troubles have taken a big bite out of improved efficiency. Time lost by breakdowns is nearly double that for the old-style machines. It's not that the new equipment breaks down more often, North American executives say; but when it does break down, it's a tedious job to isolate the source of the failure.

"The machines are so complex we can't possibly fix them ourselves," says Sidney Dahl, numerical control coordinator for the North American division. "Even the manufacturer must spend hours looking for the trouble. We may just junk the machines and buy newer, more reliable ones." Cost of the two-year-old machines now in use: $250,000 each.

Postal Problem

Officials at the new U. S. Post Office in Providence, R.I., first of a chain of highly-automated offices the Government plans to build, have found their electronic mail-canceling machine can't tell U. S. postage stamps from foreign stamps, trading stamps, or Christmas seals. The postal men say they're not worried, though; they figure letter-writers won't risk committing a Federal offense to cheat the Post Office of a few cents.

A spokesman for the Pearson Corp. of nearby Bristol, R.I., a maker of glass boats, charges the new Post Office "is really fouled up." He says it's been taking two days for his firm's correspondence to reach Boston, 60 miles away, due to tieups in Providence.

One of automation's potential pitfalls—the need for painstaking computer programming—threw U. S. missilemen into a tizzy recently. Signals from a computer-controlled radar setup at the Ballistic Missile Early Warning System station in Greenland indicated a missile attack had been launched against North America. Technicians found out, however, the signals came not from Russian rockets but from the rising moon, whose appearance had befuddled the station's inadequately-educated computer.

Such unnerving incidents prompt computer-designer George Steele, who has worked on a number of military projects, to charge that the complexity of automation in U. S. defense systems actually constitutes a threat to national security. The Atlas missile, he says, requires an entire building full of computers and other equipment to check variables in the missile's touchy fueling operation; a second computer installation is now being perfected to check on the checker. "With so much equipment, something's bound to go wrong occasionally," Mr. Steele says.

Mr. Steele, with Dr. Paul Kircher of the U.C.L.A. Business School, is the co-author of a new book, The Crisis We Face, which aims to document automation's part in U. S. missile failures.

THE FREQUENCY OF "COMPUTERS AND AUTOMATION"

The U.S. Post Office and your editors have engaged in a discussion about the frequency of **Computers and Automation,** and whether we could publish the magazine thirteen times a year, monthly with two issues in June, one a "regular" issue and the other devoted to presenting a computer directory and buyers' guide, while the magazine still retained postal second class mailing privileges.

The Post Office felt that the unusual frequency of 13 issues a year as compared with the usual frequency of 12 issues a year, and the unusual numbering scheme which we have used for the past year, and the appearance of publishing two so-called issues in one actual issue, were definitely confusing and irregular, so far as postal second class mailing privileges were concerned.

So your editors have decided to be less confusing and more regular, and to withdraw the application for reentry with publication 13 times a year, and to stick to 12 monthly issues a year, which in all cases would be clearly issues of the magazine.

Consequently, with the May issue we return to publishing 12 monthly issues of **Computers and Automation.** In these issues all the information that we want to publish will continue to be published, but the appearance and the naming of the issues we hope will be less confusing and more usual, for the benefit of everybody.

The Moral Un-Neutrality of Science

Sir Charles P. Snow
currently Visiting Professor of English
University of California
Berkeley, Calif.

(Remarks delivered at the meeting of the American Association for the Advancement of Science, New York, December 27, 1960; reprinted with permission from *Science*, January 27, 1961.)

Note from the Editor: As regular readers of *Computers and Automation* know, the subject of the social responsibilities of computer people is discussed from time to time in these columns. Also, the Association for Computing Machinery has a standing committee on Social Responsibilities of Computer People; and papers related to this subject are given from time to time at computer field meetings.

Along with the nuclear physicists who use their science to make nuclear warheads, and the propulsion scientists who use their science to make rocket motors, computer scientists use computer science to make guidance mechanisms for missiles.

This triumvirate is unlocking doomsday for the human race—if guided missiles with nuclear warheads are ever used on a large scale—and the governments of both the United States and the U.S.S.R. have declared that they will use such weapons in certain eventualities.

One of the most important recent discussions of the social responsibilities of scientists, and therefore of computer scientists, consists of the remarks of Sir Charles P. Snow in December in New York at the meeting of the AAAS. We are glad to be able to reprint these remarks so that many readers of *Computers and Automation* may be able to read and consider them.

Scientists are the most important occupational group in the world today. At this moment, what they do is of passionate concern to the whole of human society. At this moment, the scientists have little influence on the world effect of what they do. Yet, potentially, they can have great influence. The rest of the world is frightened both of what they do—that is, of the intellectual discoveries of science—and of its effect. The rest of the world, transferring its fears, is frightened of the scientists themselves and tends to think of them as radically different from other men.

As an ex-scientist, if I may call myself so, I know that is nonsense. I have even tried to express in fiction some kinds of scientific temperament and scientific experience. I know well enough that scientists are very much like other men. After all, we are all human, even if some of us don't give that appearance. I think I would be prepared to risk a generalization. The scientists I have known (and because of my official life I have known as many as anyone in the world) have been in certain respects just perceptibly more morally admirable than most other groups of intelligent men.

That is a sweeping statement, and I mean it only in a statistical sense. But I think there is just a little in it. The moral qualities I admire in scientists are quite simple ones, but I am very suspicious of attempts to oversubtilize moral qualities. It is nearly always a sign, not of true sophistication, but of a specific kind of triviality. So I admire in scientists very simple virtues—like courage, truth-telling, kindness—in which, judged by the low standards which the rest of us manage to achieve, the scientists are not deficient. I think on the whole the scientists make slightly better husbands and fathers than most of us, and I admire them for it. I don't know the figures, and I should be curious to have them sorted out, but I am prepared to bet that the proportion of divorces among scientists is slightly but significantly less than that among other groups of similar education and income. I do not apologize for considering that a good thing.

A close friend of mine is a very distinguished scientist. He is also one of the few scientists I know who has lived what we used to call a Bohemian life. When we were both younger, he thought he would undertake historical research to see how many great scientists had been as fond of women as he was. I think he would have felt mildly supported if he could have found a precedent. I remember his reporting to me that his researches hadn't had any luck. The really great scientists seemed to vary from a few neutral characters to a large number who were depressingly "normal." The only gleam of comfort was to be found in the life of Jerome Cardan; and Cardan wasn't anything like enough to outweigh all the others.

So scientists are not much different from other men. They are certainly no worse than other men. But they differ from other men in one thing. That is the point I started with. Whether they like it or not, what they do is of critical importance for the human race. Intellectually, it has transformed the climate of our time. Socially, it will decide whether we live or die, and how we live or die. It holds decisive powers for good and evil. *That* is the situation in which the scientists find themselves. They may not have asked for it, or many only have asked for it in part, but they cannot escape it. They think, many of the more sensitive of them, that they don't deserve to have this weight of responsibility heaved upon them. All they want to do is to get on with their work. I sympathize. But the scientists can't escape the responsibility—any more than they, or the rest of us, can escape the gravity of the moment in which we stand.

Doctrine of Ethical Neutrality

There is of course one way to contract out. It has been a favorite way for intellectual persons caught in the midst of water too rough for them.

It consists of the invention of categories—or, if you like, of the division of moral labor. That is, the scientists who want to contract out say, *we* produce the tools. *We* stop there. It is for *you*—the rest of the world, the politicians—to say how the tools are used. The tools may be used for purposes which most of us would regard as bad. If so, we are sorry. But as scientists, that is no concern of ours.

This is the doctrine of the ethical neutrality of science. I can't accept it for an instant. I don't believe any scientists of serious feeling can accept it. It is hard, some think, to find the precise statements which will prove it wrong. Yet we nearly all feel intuitively that the invention of comfortable categories is a moral trap. It is one of the easier methods of letting the conscience rust. It is exactly what the early 19th century economists, such as Ricardo, did in the face of the facts of the first industrial revolution. We wonder now how men, intelligent men, can have been so morally blind. We realize how the exposure of that moral blindness gave Marxism its apocalyptic force. We are now, in the middle of the scientific or second industrial revolution, in something like the same position as Ricardo. Are we going to let our consciences rust? Can we ignore that intimation we nearly all have, that scientists have a unique responsibility? Can we believe it, that science is morally neutral?

To me—it would be dishonest to pretend otherwise—there is only one answer to those questions. Yet I have been brought up in the presence of the same intellectual categories as most western scientists. It would also be dishonest to pretend that I find it easy to construct a rationale which expresses what I now believe. The best I can hope for is to fire a few sighting shots. Perhaps someone who sees more clearly than I can will come along and make a real job of it.

The Beauty of Science

Let me begin with a remark which seems some way off the point. Anyone who has ever worked in any science knows how much esthetic joy he has obtained. That is, in the actual activity of science, in the process of making a discovery, however humble it is, one can't help feeling an awareness of beauty. The subjective experience, the esthetic satisfaction, seems exactly the same as the satisfaction one gets from writing a poem or a novel, or composing a piece of music. I don't think anyone has succeeded in distinguishing between them. The literature of scientific discovery is full of this esthetic joy. The very best communication of it that I know comes in G. H. Hardy's book, *A Mathematician's Apology*. Graham Greene once said he thought that, along with Henry James's prefaces, this was the best account of the artistic experience ever written. But one meets the same thing throughout the history of science. Bolyai's great yell of triumph when he saw he could construct a self-consistent, non-Euclidean geometry; Rutherford's revelation to his colleagues that he knew what the atom was like; Darwin's slow, patient, timorous certainty that at last he had got there—all these are the voices, different voices, of esthetic ecstasy.

That is not the end of it. The result of the activity of science, the actual finished piece of scientific work, has an esthetic value in itself. The judgments passed on it by other scientists will more often than not be expressed in esthetic terms: "That's beautiful!" or "That really is very pretty!" (as the understating English tend to say). The esthetics of scientific constructs, like the esthetics of works of art, are variegated. We think some of the great syntheses, like Newton's, beautiful because of their classical simplicity, but we see a different kind of beauty in the relativistic extension of the wave equation or the interpretation of the structure of deoxyribonucleic acid, perhaps because of the touch of unexpectedness. Scientists know their kinds of beauty when they see them. They are suspicious, and scientific history shows they have always been right to have been so, when a subject is in an "ugly" state. For example, most physicists feel in their bones that the present bizarre assembly of nuclear particles, as grotesque as a stamp collection, can't possibly be, in the long run, the last word.

We should not restrict the esthetic values to what we call "pure" science. Applied science has its beauties, which are, in my view, identical in nature. The magnetron has been a marvelously useful device, but it was a beautiful device, not exactly apart from its utility but because it did, with such supreme economy, precisely what it was designed to do. Right down in the field of development, the esthetic experience is as real to engineers. When they forget it, when they begin to design heavy-power equipment about twice as heavy as it needs to be, engineers are the first to know that they are lacking virtue.

There is no doubt, then, about the esthetic content of science, both in the activity and the result. But esthetics has no connection with morals, say the categorizers. I don't want to waste time on peripheral isues—but are you quite sure of that? Or is it possible that these categories are inventions to make us evade the human and social conditions in which we now exist? But let us move straight on to something else, which is right in the grain of the activity of science and which is at the same time quintessentially moral. I mean, the desire to find the truth.

The Search for Truth

By *truth*, I don't intend anything complicated, once again. I am using the word as a scientist uses it. We all know that the philosophical examination of the concept of empirical truth gets us into some curious complexities, but most scientists really don't care. They know that the truth, as they use the word and as the rest of us use it in the language of common speech, is what makes science work. That is good enough for them. On it rests the whole great edifice of modern science. They have a sneaking sympathy for Rutherford, who, when asked to examine the philosophical bases of science, was inclined to reply, as he did to metaphysician Samuel Alexander: "Well, what have you been talking all your life, Alexander? Just hot air! Nothing but hot air!"

Anyway, truth in their own straight-forward sense is what the scientists are trying to find. They want to find what is *there*. Without that desire, there is no science. It is the driving force of the whole activity. It compels the scientist to have an overriding respect

for truth, every stretch of the way. That is, if you're going to find what is *there,* you mustn't deceive yourself or anyone else. You mustn't lie to yourself. At the crudest level, you mustn't fake your experiments.

Curiously enough, scientists do try to behave like that. A short time ago, I wrote a novel in which the story hinged on a case of scientific fraud. But I made one of my characters, who was himself a very good scientist, say that, considering the opportunities and temptations, it is astonishing how few such cases there are. We have all heard of perhaps half a dozen open and notorious ones, which are on the record for anyone to read—ranging from the "discovery" of the L radiation to the singular episode of the Piltdown man.

We have all, if we have lived any time in the scientific world, heard private talk of something like another dozen cases which for various reasons are not yet public property. In some cases, we know the motives for the cheating—sometimes, but not always, sheer personal advantage, such as getting money or a job. But not always. A special kind of vanity has led more than one man into scientific faking. At a lower level of research, there are presumably some more cases. There must have been occasional Ph.D. students who scraped by with the help of a bit of fraud.

But the total number of all these men is vanishingly small by the side of the total number of scientists. Incidentally, the effect on science of such frauds is also vanishingly small. Science is a self-correcting system. That is, no fraud (or honest mistake) is going to stay undetected for long. There is no need for an extrinsic scientific criticism, because criticism is inherent in the process itself. So that all that a fraud can do is waste the time of the scientists who have to clear it up.

The remarkable thing is not the handful of scientists who deviate from the search for truth but the overwhelming numbers who keep to it. That is a demonstration, absolutely clear for anyone to see, of moral behavior on a very large scale.

We take it for granted. Yet it is very important. It differentiates science in its widest sense (which includes scholarship) from all other intellectual activities. There is a built-in moral component right in the core of the scientific activity itself. The desire to find all truth is itself a moral impulse, or at least contains a moral impulse. The way in which a scientist tries to find the truth imposes on him a constant moral discipline. We say a scientific conclusion—such as the contradiction of parity by Lee and Yang—is "true" in the limited sense of scientific truth, just as we say that it is "beautiful" according to the criteria of scientific esthetics. We also know that to reach this conclusion took a set of actions which would have been useless without the moral nature. That is, all through the marvelous experiments of Wu and her colleagues, there was the constant moral exercise of seeking and telling the truth. To scientists, who are brought up in this climate, this seems as natural as breathing. Yet it is a wonderful thing. Even if the scientific activity contained only this one moral component, that alone would be enough to let us say that it was morally un-neutral.

But is this the only moral component? All scientists would agree about the beauty and the truth. In the western world, they wouldn't agree on much more. Some will feel with me in what I am going to say. Some will not. That doesn't affect me much, except that I am worried by the growth of an attitude I think very dangerous, a kind of technological conformity disguised as cynicism. I shall say a little more about that later. As for disagreement, G. H. Hardy used to comment that a serious man ought not to waste his time stating a majority opinion—there are plenty of others to do that. That was the voice of classical scientific nonconformity. I wish that we heard it more often.

Science in the Twenties

Let me cite some grounds for hope. Any of us who were working in science before 1933 can remember what the atmosphere was like. It is a terrible bore when aging men in their fifties speak about the charms of their youth. Yet I am going to irritate you—just as Talleyrand irritated his juniors—by saying that unless one was on the scene before 1933, one hasn't known the sweetness of the scientific life. The scientific world of the twenties was as near to being a full-fledged international community as we are likely to get. Don't think I'm saying that the men involved were superhuman or free from the ordinary frailties. That wouldn't come well from me, who have spent a fraction of my writing life pointing out that scientists are, first and foremost, men. But the atmosphere of the twenties in science was filled with an air of benevolence and magnanimity which transcended the people who lived in it.

Anyone who ever spent a week in Cambridge or Göttingen or Copenhagen felt it all round him. Rutherford had very human faults, but he was a great man with abounding human generosity. For him the world of science was a world that lived on a plane above the nation-state, and lived there with joy. That was at least as true of those two other great men, Niels Bohr and Franck, and some of that spirit rubbed off on to the pupils round them. The same was true of the Roman school of physics.

The personal links within this international world were very close. It is worth remembering that Peter Kapitza, who was a loyal Soviet citizen, honored my country by working in Rutherford's laboratory for many years. He became a fellow of the Royal Society, a fellow of Trinity College, Cambridge, and the founder and kingpin of the best physics club Cambridge has known. He never gave up his Soviet citizenship and is now director of the Institute of Physical Problems in Moscow. Through him a generation of English scientists came to have personal knowledge of their Russian colleagues. These exchanges were then, and have remained, more valuable than all the diplomatic exchanges ever invented.

The Kapitza phenomenon couldn't take place now. I hope to live to see the day when a young Kapitza can once more work for 16 years in Berkeley or Cambridge and then go back to an eminent place in his own country. When that can happen, we are all right. But after the idyllic years of world science, we passed into a tempest of history, and, by an unfortunate coincidence, we passed into a technological tempest too.

The discovery of atomic fission broke up the world

of international physics. "This has killed a beautiful subject," said Mark Oliphant, the father figure of Australian physics, in 1945, after the bombs had dropped. In intellectual terms, he has not turned out to be right. In spiritual and moral terms, I sometimes think he has.

A good deal of the international community of science remains in other fields—in great areas of biology, for example. Many biologists are feeling the identical liberation, the identical joy at taking part in magnanimous enterprise, that physicists felt in the twenties. It is more than likely that the moral and intellectual leadership of science will pass to biologists, and it is among them that we shall find the Rutherfords, Bohrs, and Francks of the next generation.

The Physicist, a Military Resource

Physicists have had a bitterer task. With the discovery of fission, and with some technical breakthroughs in electronics, physicists became, almost overnight, the most important military resource a nation-state could call on. A large number of physicists became soldiers not in uniform. So they have remained, in the advanced societies, ever since.

It is very difficult to see what else they could have done. All this began in the Hitler war. Most scientists thought then that Nazism was as near absolute evil as a human society can manage. I myself thought so. I still think so, without qualification. That being so, Nazism had to be fought, and since the Nazis might make fission bombs—which we thought possible until 1944, and which was a continual nightmare if one was remotely in the know—well, then, we had to make them too. Unless one was an unlimited pacifist, there was nothing else to do. And unlimited pacificism is a position which most of us cannot sustain.

Therefore I respect, and to a large extent share, the moral attitudes of those scientists who devoted themselves to making the bomb. But the trouble is, when you get onto any kind of moral escalator, to know whether you're ever going to be able to get off. When scientists became soldiers they gave up something, so imperceptibly that they didn't realize it, of the full scientific life. Not intellectually. I see no evidence that scientific work on weapons of maximum destruction has been in any intellectual respect different from other scientific work. But there is a moral difference.

It may be—scientists who are better men than I am often take this attitude, and I have tried to represent it faithfully in one of my books—that this is a moral price which, in certain circumstances, has to be paid. Nevertheless, it is no good pretending that there is not a moral price. Soldiers have to obey. That is the foundation of their morality. It is not the foundation of the scientific morality. Scientists have to question and if necessary to rebel. I don't want to be misunderstood. I am no anarchist. I am not suggesting that loyalty is not a prime virtue. I am not saying that all rebellion is good. But I am saying that loyalty can easily turn into conformity, and that conformity can often be a cloak for the timid and self-seeking. So can obedience, carried to the limit. When you think of the long and gloomy history of man, you will find that far more, and far more hideous, crimes have been committed in the name of obedience than have ever been committed in the name of rebellion. If you doubt that, read William Shirer's "Rise and Fall of the Third Reich." The German officer corps were brought up in the most rigorous code of obedience. To them, no more honorable and God-fearing body of men could conceivably exist. Yet in the name of obedience, they were party to, and assisted in, the most wicked large-scale actions in the history of the world.

Scientists must not go that way. Yet the duty to question is not much of a support when you are living in the middle of an organized society. I speak with feeling here. I was an official for 20 years. I went into official life at the beginning of the war, for the reasons that prompted my scientific friends to begin to make weapons. I stayed in that life until a year ago, for the same reason that made my scientific friends turn into civilian soldiers. The official's life in England is not quite so disciplined as a soldier's, but it is very nearly so. I think I know the virtues, which are very great, of the men who live that disciplined life. I also know what for me was the moral trap. I, too, had got onto an escalator. I can put the result in a sentence: I was coming to hide behind the institution; I was losing the power to say no.

A Spur to Moral Action

Only a very bold man, when he is a member of an organized society, can keep the power to say no. I tell you that, not being a very bold man, or one who finds it congenial to stand alone, away from his colleagues. We can't expect many scientists to do it. Is there any tougher ground for them to stand on? I suggest to you that there is. I believe that there is a spring of moral action in the scientific activity which is at least as strong as the search for truth. The name of this spring is *knowledge.* Scientists *know* certain things in a fashion more immediate and more certain than those who don't comprehend what science is. Unless we are abnormally weak or abnormally wicked men, this knowledge is bound to shape our actions. Most of us are timid, but to an extent, knowledge gives us guts. Perhaps it can give us guts strong enough for the jobs in hand.

I had better take the most obvious example. All physical scientists *know* that it is relatively easy to make plutonium. We know this, not as a journalistic fact at second hand, but as a fact in our own experience. We can work out the number of scientific and engineering personnel needed for a nation-state to equip itself with fission and fusion bombs. We *know* that, for a dozen or more states, it will only take perhaps six years, perhaps less. Even the best informed of us always exaggerate these periods.

This we know, with the certainty of—what shall I call it?—engineering truth. We also—most of us—are familiar with statistics and the nature of odds. We know, with the certainty of statistical truth, that if enough of these weapons are made, by enough different states, some of them are going to blow up, through accident, or folly, or madness—the motives

don't matter. What does matter is the nature of the statistical fact.

All this we *know*. We know it in a more direct sense than any politician because it comes from our direct experience. It is part of our minds. Are we going to let it happen?

All this we *know*. It throws upon scientists a direct and personal responsibility. It is not enough to say that scientists have a responsibility as citizens. They have a much greater one than that, and one different in kind. For scientists have a moral imperative to say what they know. It is going to make them unpopular in their own nation-states. It may do worse than make them unpopular. That doesn't matter. Or at least, it does matter to you and me, but it must not count in the fact of the risks.

Alternatives

For we genuinely know the risks. We are faced with an either-or, and we haven't much time. The *either* is acceptance of a restriction of nuclear armaments. This is going to begin, just as a token, with an agreement on the stopping of nuclear tests. The United States is not going to get the 99.9 per cent "security" that it has been asking for. This is unobtainable, though there are other bargains that the United States could probably secure. I am not going to conceal from you that this course involves certain risks. They are quite obvious, and no honest man is going to blink them. That is the *either*. The *or* is not a risk but a certainty. It is this. There is no agreement on tests. The nuclear arms race between the United States and the U.S.S.R. not only continues but accelerates. Other countries join in. Within, at the most, six years, China and several other states have a stock of nuclear bombs. Within, at the most, ten years, some of these bombs are going off. I am saying this as responsibly as I can. *That* is the certainty. On the one side, therefore, we have a finite risk. On the other side we have a certainty of disaster. Between a risk and a certainty, a sane man does not hesitate.

It is the plain duty of scientists to explain this either-or. It is a duty which seems to me to come from the moral nature of the scientific activity itself.

The same duty, though in a much more pleasant form, arises with respect to the benevolent powers of science. For scientists know, and again with the certainty of scientific knowledge, that we possess every scientific fact we need to transform the physical life of half the world. And transform it within the span of people now living. I mean, we have all the resources to help half the world live as long as we do and eat enough. All that is missing is the will. We *know* that. Just as we know that you in the United States, and to a slightly lesser extent we in the United Kingdom, have been almost unimaginably lucky. We are sitting like people in a smart and cozy restaurant and we are eating comfortably, looking out of the window into the streets. Down on the pavement are people who are looking up at us, people who by chance have different colored skins from ours, and are rather hungry. Do you wonder that they don't like us all that much? Do you wonder that we sometimes feel ashamed of ourselves, as we look out through that plate glass?

Well, it is within our power to get started on that problem. We are morally impelled to. We all know that, if the human species does solve that one, there will be consequences which are themselves problems. For instance, the population of the world will become embarrassingly large. But that is another challenge. There are going to be challenges to our intelligence and to our moral nature as long as man remains man. After all, a challenge is not, as the word is coming to be used, an excuse for slinking off and doing nothing. A challenge is something to be picked up.

For all these reasons, I believe the world community of scientists has a final responsibility upon it—a greater responsibility than is pressing on any other body of men. I do not pretend to know how they will bear this responsibility. These may be famous last words, but I have an inextinguishable hope. For, as I have said, there is no doubt that the scientific activity is both beautiful and truthful. I cannot prove it, but I believe that, simply because scientists cannot escape their own knowledge, they also won't be able to avoid showing themselves disposed to good.

Automatic Machine Scheduling

J. C. Hammerton
Stamford, Conn.

The purpose of this article is to discuss methods by which a computer can schedule its own operations. In a multi-computer installation with a multi-project workload, scheduling is a formidable clerical task. As business electronic data processing (EDP) enters a production phase, a flexible, error-free scheduling method is required. Also, there is an effect of automatic machine scheduling (AMS) on EDP systems design, and this also is discussed.

In the first six years of business electronic data-processing one of the more significant advances has phases of the programming function. This recognition is manifested in more productive employment of programming talent and in the use of the computer been the recognition of the repetitive nature of many to perform the clerical phases of programming.

The next six years should witness a similar revolution in the machine scheduling function. This function includes the planning of machine schedules and the production of working instructions to implement the schedules.

Both of these tasks require a large quantity of clerical work and a modicum of simple decision-making. In general they are performed on a daily basis. In installations with a well-established, cyclic workload

some parts of previous schedules may be recoverable. However, the working instructions usually have to be reformulated because, for example, of changes in tape reel numbers.

The bulk of this scheduling task can be assumed by any general-purpose computer. With increasing sophistication certain alterations in system configuration and equipment design will prove necessary to develop the full potential of automatic machine scheduling.

A number of factors will influence the development of this unglamorous but essential function.

The Need for Automatic Machine Scheduling

The need for improved techniques of machine scheduling arises from the emergence of business EDP into a production phase, the trend to multi-machine and multi-computer installations, the increased complexity of the over-all operations, and the pressure to reduce operating costs.

THE PRODUCTION PHASE. At this time the "pioneer" users of EDP systems have survived through two, or even three, generations of computers and have emerged from the initial phase of EDP. This phase was, and still is, characterized by a fumbling approach to the task, by a face-saving emphasis on "up-time," and by considerations of company prestige. The termination of this phase is marked by a realistic effort to cost the work done on the EDP installation. The feature which is the hallmark of the change is the abandonment of up-time as the measure of an installation's health. In its place the "ratio of occupied time to running time" becomes the yardstick. This ratio draws attention, for example, to inadequate provision for the initial setting-up of an operation and to poor tape-changing procedures during an operation.

Automatic machine scheduling is expected to eliminate errors in the schedule and, because an iterative optimization process can be employed economically, to provide a better schedule.

MULTI-COMPUTER INSTALLATION. Multi-machine, single-computer installations are commonplace. However, the trend to multi-computer installations is new in the business world.

Heretofore technical obsolescence has reinforced the arguments for obtaining a single, faster, bigger, newer computer instead of adding a second computer of the type already in use. Acceptance of the transistorized time-sharing data-processor will probably lead to a reduction in the rate of technical obsolescence and hence to the emergence of multi-computer installations.

Business machines of the new generation although modular in terms of memory size and peripheral equipments, do not permit duplication of program control. Consequently as a company's workload increases the acquisition of a second computer becomes necessary.

The second computer introduces another dimension of complexity into the machine scheduling with respect to both the planned schedule and the emergency schedule. With only one computer unscheduled maintenance "ices" the machine schedule almost completely. With two or more computers, the work can be redistributed among those machines which remain "up."

MULTI-PROJECT WORKLOAD. Reported case histories of conversions to EDP cover the full range from more or less immediate success to real trouble. In general, the companies reporting "success" appear to be those who established a well-defined lead project. This enabled them to concentrate their analytical and programming efforts, to discover and solve the computer-type problems, and to advance the learning process uniformly among their EDP personnel.

Emergence into a production phase is concurrent in many cases with an expansion into new areas of the company. This imparts a multi-project look to the workload of the EDP installation. The operations become more varied in cycle, duration, and ancillary equipment.

In addition the "converted tabulating operation" gives way to projects which make better use of the potential power of electronic data-processing systems. Output data from operations for different departments may be consolidated into unified management summary reports.

The net effects are an increase in the over-all complexity of the installation's work and an increase in its interdependence. The result is complication of the machine scheduling.

REDUCTION OF OPERATING COSTS. As the complexity of the machine scheduling increases, the clerical effort required for formulating and verifying the schedule multiplies.

Customarily, emergence into a production phase is accompanied by pressure to reduce operating costs. Automatic machine scheduling becomes an important possibility at this juncture.

The Scheduling Process

The scheduling process begins with the input data required and the output data prepared under present manual procedures.

The input data consists of the following:—

(1) a List of Operations, which shows the prerequisite operations for each one and whether these have been performed;

(2) an Operations History Log, which contains predicted running times, the identity of the input reels, the number of output reels to be assigned, the console data to be supplied as part of the operation, etc.

The output data consists of the following:—

(1) a Machine Schedule Chart, which is a master plan of the operations to be performed,

(2) a Time Bar-Chart for each machine, showing the relationship of each machine to the over-all schedule,

(3) the list of assignment of tape reels to tape-handlers,

(4) operating instructions for the console operators, the tape librarian, and the tape clerks.

The additional data accumulated for historical purposes are as follows:—

(1) operations history data, which includes transaction volumes, running times, and percentage occupancy of tape reels,

(2) reel history log, which shows whether a reel contains useful data or whether it is available for assignment as an output tape.

Automatic Scheduling Methods

For convenience automatic scheduling methods can be classified as "prediction," "one-ahead," and "demand" scheduling.

PREDICTION SCHEDULING. Prediction scheduling describes a method in which a special computer run is used to prepare all instructions for the day's (shift's) operations. It is the mechanized equivalent of the standard manual procedures. To avoid unnecessary uncertainties the scheduling operation will normally be the last operation of the previous day (or shift). The work accomplished in the previous day is then a known quantity.

Changes in the predicted schedule will arise due to delays in the delivery of input data, unscheduled down-time, and underestimates of running times. The changes are effected with the aid of the machine schedule chart through a system of "change notices." These modify instructions already issued to the operating personnel.

Prediction scheduling produces the working outputs and historical records for a day's operations. It is within the capabilities of most of the general-purpose data-processing systems which are marketed currently.

However, the method is difficult to apply in installations where a typical day's workload includes several departures from the prepared schedule.

DEMAND SCHEDULING. Manual prediction scheduling is equally difficult to apply under the same conditions since the same number of changes have to be made to the working instructions and the historical data. In order to avoid these changes it is necessary to schedule each operation closer to the time at which it will be run. The ultimate in this direction is "demand scheduling." With this method a new operation is scheduled when the previous operation has been completed.

In general this is impracticable with a manual system because of the time taken to prepare and distribute new working instructions. However, demand scheduling represents the goal of automatic machine scheduling.

On completion of an operation a computer is given access to the store or stores of scheduling data. The successful completion of the previous operation is recorded and contingent actions, such as the release of "grandfather" tapes, are performed. Amendments to the scheduling data are introduced through punched cards or paper tape. These amendments consist of the receipt of input data from other departments, revisions to the available complement of tape-handlers, and other items which affect the scheduling process. The computer then determines the next operation to be run on the basis of fulfilled prerequisites and of established priorities. Working instructions are printed on an on-line printer. In the most automated case the computer is able to make its own connections to tape-handlers. The working instructions in this case are prepared as a guide in the handling of unscheduled interruptions.

Modern data-processing systems are not suitable for demand scheduling principally because of the intimate association of the tape-handlers and the peripheral devices with particular computers. This rigid grouping has been adopted for reasons of close operating control and lower cost. However, these reasons lose some of their power as equipment reliability increases and as operating experience with multi-computer installations reveals the hidden costs inherent in the inflexibility.

Demand scheduling requires the following minimum capabilities in the over-all system:

(a) any-to-any connections between the computers and the tape-handlers,

(b) control switches governing these connections, and

(c) an on-line printer (or printers) accessible to all the computers in the installation.

The first requirement is necessary for two reasons, to provide all the computers access to a common source of scheduling data and to permit rapid connection of a computer to the correct tape-handlers once an operation has been scheduled.

The control of these connections can be manual or automatic. If manual, the computer prints connection instructions during the course of scheduling a new operation. If automatic, the computer must be able to communicate with the switching unit through a sub-system which it shares with the other computers.

The third requirement is close to the standard option available with most of the modern data-processing systems. It provides the means of communicating with a control position.

Pre-mounting Tapes

These systems requirements are minimal because of the necessity for mounting reels of tape on designated tape-handlers at some stage. Because of the delays involved it is unsatisfactory to withdraw and mount tapes at the time that an operation is scheduled. With the minimal capabilities cited above it is necessary to pre-mount tapes on the basis of predicted tape-handler assignments.

Pre-mounting tapes is a compromise procedure. In essence it implies that a prediction scheduling operation is made in order to forecast the probable course of the demand scheduling. On the basis of this prediction the tape-handlers can be scheduled for the day or shift. Instructions are prepared showing the sequence in which tape reels are to be mounted on each tape-handler. These assignments are also recorded magnetically as part of the scheduling data. Consequently during the day when a computer schedules an operation, the numbers of the tape-handlers associated with the required reel numbers can be recovered and used.

Departures from the predicted schedule arise due to non-availability of input data, unscheduled down-time of a tape-handler, or the occupation of a tape-handler during an operation for longer than the predicted time. Any of these contingencies may result in a tape-handler not being available when required or, if available, having the wrong reel of tape mounted on it. The on-line intervention of the shift supervisor is required to circumvent these departures. The availabil-

ity of a "spare percentage" of tape-handlers is important if forced computer idle time is to be avoided.

Automated Tape Library

In order to extend true demand scheduling to the mounting of tape reels, the system capabilities must be extended to include automation of the tape library.

Association of each reel of tape with its own servo-mechanism and reading/writing head appears to be prohibitive on a cost basis. Limited attempts have been made to do this in the past in cases where only a relatively few reels of tape were involved. However, the tape library of the modern EDP installation runs to thousands of tape reels.

The practical alternative is to mechanize the existing manual procedure.

Under a typical manual procedure the computer or a scheduler prepares a tape-mounting instruction for a reel of tape. Using this instruction a tape librarian locates the required reel and issues it to a tape clerk who mounts it on the assigned tape-handler.

The most difficult part of this procedure to automate is the actual mounting of the tape reel. To accomplish this tape-handlers are required with some radically new design features. Furthermore with experienced tape clerks this part of the manual procedure contributes least to the total delay providing enough clerks are available to mount the initial tape reels for an operation.

Subject to this last proviso it appears that automating the extraction, issuance, routing, and transportation of the tape reels may be sufficient to permit demand-scheduling of the tape-handlers.

One-ahead Scheduling

"One-ahead" scheduling is a compromise method. Prediction scheduling may result in a high volume of changes which have to be effected through the manual exception scheduling. On the other hand true demand scheduling requires certain system capabilities which are not now available and which are expensive.

In order to gain some of the benefits of demand scheduling without incurring the cost of the extensions to the system the computers can schedule one operation ahead. At the start of one operation a computer schedules the operation which it will undertake at the conclusion of the operation it is about to start. This sequencing provides time for the mounting of tape reels.

System Implications

The system implications of automatic machine scheduling vary from negligible in the case of prediction scheduling to far-reaching in the case of demand scheduling.

For demand scheduling the implications are as follows:

(1) an "any-to-any" switch interconnecting tape-handlers and computers,
(2) the ability of any computer to operate this switch through an actuating unit,
(3) access from any computer to a common store of scheduling data,
(4) access from any computer to a monitor printer or printers at the control position,
(5) access from the control position to any compu-

ter, using a keyset either directly or via paper tape,

(6) access from the control position to the scheduling data to notify the system of the availability of input data, the non-availability of equipment, etc.,

(7) a series of status indications for each unit machine in the installation showing whether it is "idle," "busy," or "down,"

(8) peripheral devices working "on-line" to the computers so that the computers can schedule the peripheral operations,

(9) an automated tape library which can be controlled by any computer,

(10) tape-handlers capable of automatic loading and able to indicate to a computer whether they are "operating," "rewinding," "loading," or "down,"

(11) a time-of-day clock accessible to each computer for purposes of establishing and recording running times, loading times, occupied times, etc.

ON-LINE PERIPHERAL DEVICES. The use of peripheral devices which operate on-line to the computer enables the computer to schedule the peripheral operations. The only external information required is that input data have been received by the data-processing department. On-line operation permits tighter control of the system since all tapes can be controlled in the same manner, e.g., checking of header messages, formation of internal audit controls.

On-line peripheral devices require a machine organization which can process print-outs and read-ins on a request or time-sharing basis. The program which the computer is processing, is interrupted in order to service the peripheral device requesting attention. This type of organization is common to a greater or lesser degree in most modern EDP systems.

MONITOR PRINTERS. The monitor printers at the control position are used by the computers for the following purposes:

(1) to inform the supervisor of the operations which are scheduled, the tape-handlers which are assigned, etc.,

(2) to inform the supervisor of reasons for not being able to schedule further work, e.g., a prerequisite operation is being run on another computer,

(3) to indicate the reason for unscheduled stops, e.g., machine malfunctions, "illogical" input data, wrong input tape on a tape-handler, an "unreleased" tape on an output tape-handler, etc.

The time-of-day clock is one of the key features of the efficient EDP installation of the future. Given access to such a clock, a computer is able to compile statistics on running time, occupied time, unscheduled time, program testing time, and scheduling time both for itself and for the peripheral devices. The running time of tape-handlers can also be compiled. A clock is essential to an AMS procedure because of the necessity for accurate historical data on the running times of operations. It is a necessary feature of an efficient EDP installation because it removes the guesswork, errors, and psychological factors which are present in

the time-keeping records maintained by human operators.

Feasibility and Adoption of AMS

AMS does not preclude the insertion of work not covered by the regular scheduling data. Such work may be either low-priority fill-in work or high-priority work such as the preparation of special reports.

Fill-in work is no problem since it is only scheduled when a computer is unable to find another job to do. It can be scheduled in increments of ten to twenty minutes so that at the conclusion of an increment the computer can search the scheduling data again.

However, AMS will not prove satisfactory in an installation characterized by routine, high-priority, "crash" work. Prediction scheduling requires a well-defined work-load with good historical records of input volume, output volume, and running times. Demand scheduling provides greater flexibility but the work schedule still has to be coordinated with the delivery of input data and the required production dates for output data.

In practice, demand scheduling is likely to be approached via a well-tried well-understood manual system followed by a predicted AMS system. This is desirable since the control of the schedule and occasional manual intervention necessitate a thorough understanding of the automatic scheduling procedure. Even with demand scheduling the preparation of a predicted schedule at the start of a shift is advisable. The outputs of this run will be working documents for the supervisor so that he can follow the course of the day's operations and, if necessary, make additions or changes to the schedule.

READERS' AND EDITOR'S FORUM

(Continued from Page 8)

ran 1939-41. They seek to make sure that another surprise attack, like the Japanese attack on Pearl Harbor on December 7, 1941, will be very unprofitable to the attacker.

What about this kind of work, and the social responsibilities of computer people?

2. Change in the Art of War

The answer to this question, I think, flows out of realizing that during the years 1945 to 1954 the world of man went through a major discontinuity in the art of war. The H-Bomb that exploded at Bikini Atoll in March, 1954, was equivalent in explosive power to 20 million tons of TNT. In power that one bomb had 6 times the explosive power of *all* the bombs dropped by *all* sides in *all* the years of World War II. Does not this change war?

The heat flashes from several dozen giant nuclear bombs, if exploded appropriately over the eastern region of the United States, would set fire to all the forests of the Appalachians from Maine to Virginia, and burn them down. Does not this change war?

From the single A-bomb that fell on Hiroshima, more Japanese (over 100,000) have died *after* the end of the war, than died at the time of its explosion (70,000). Does not this change war?

There is perhaps no upper limit to the destructive power of nuclear bombs. Harrison Brown (in "The Community of Fear" published by the Center for the Study of Democratic Institutions, Santa Barbara, Calif.) speaks of a single 500 megaton nuclear bomb "that could sear six Western States." Does not this change war?

3. New Situation

Because of these discontinuities in the art of war, the world of man is in an entirely new situation. Standard words have lost their old meanings. Offense has become suicide. Defense has become suicide. And even if it is argued that these statements are exaggerations, the whirlwind march of scientific breakthroughs over the next twenty years and the long future beyond that, are likely to make them true.

The doggerel epitaph of John O'Day has a lesson for us: "Here lies the body of John O'Day—He died defending his right of way—He was right, dead right, as he sped along—But he's just as dead as if he were wrong."

The people who plan nuclear war including guided missiles and the computers which direct them are playing a game which, if it ever becomes real on a large scale, results in wiping out almost all civilization as we know it, and the death of hundreds of millions of human beings, democratic or not, Communist or not, neutral or not. Supposing you have a right to kill yourself, and your enemy, do you still have a right to kill a million bystanders?

4. New Response to a New Situation

The new situation requires a new response. The moral position that war is wrong agrees with the realist position that large scale war has become so destructive that it ceases to make much sense. The thesis of Herman Kahn's book "On Thermonuclear War" (published by Princeton University Press) seems to be "You can plan and get away with nuclear war, if you can accept the death of X million Americans"; the the counting begins at two million American dead and goes up to 160 million. But the thesis is in fact disproved, for if you read the book carefully, you will find that there are many kinds of thermonuclear war, and for some of the kinds, no one gets away with it.

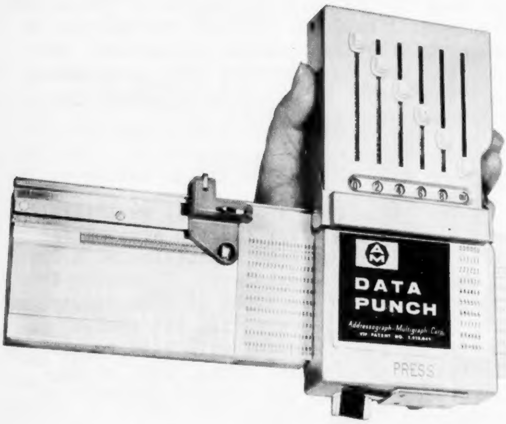
So the energies of the planners need to go in a new direction, since large-scale war is now homicidal on the vastest scale. This direction is the prevention of war, studied and prepared with the same intensity as standard military problems. This direction includes technologies of inspection, intercultural contacts, the softening of differences through conciliation, development of strategies of peaceful competition, multiplying understandings between all countries on the model of that between Canada and the United States, research and development for lasting peace, etc.

If there were a raging fire in his computer center, a computer person would set to work to put it out. There is a raging danger from nuclear weapons in the world today, and computer people should help to bring that danger under control.

MANUAL PUNCH FOR PUNCH CARDS

Addressograph-Multigraph Corp.
Cleveland, Ohio

This company has developed a Tom Thumb-sized business machine -- 8 1/2" x 4 1/4" x 1 1/2" -- weighing only 2 1/2 pounds -- which talks computer language right from the start. Called the Addressograph Data Punch, it records data in standard punch card code directly on a tabulating card -- at the point of origin. Cards prepared in this way can be fed directly into any data processing system without transcription or additional preparatory steps. Unlike previous hand punches, this punch simultaneously interprets in printed characters. In this way the data being punched into the card can be easily verified and referred to.



This is how the punch works:

A tabulating card is inserted into the punch. The area to be punched is selected by means of a field indexing gage. Data to be punched and printed is entered by positioning a series of keys. What has been entered is visible on dials for quick visual verification. An operating lever is then pressed to complete the punched card. Conventional 80 or 51 column cards or multiple part card sets may be used.

The punch can be used wherever source data must be gathered at locations other than the data processing site. Typical uses are: stock requisitioning, inventory, tool control, machine production recording, etc.

BANKS WILL TAKE OVER ACCOUNTING TASKS OF INDUSTRIAL FIRMS: PREDICTION

Armour Research Inst.
Illinois Inst. of Technology
35 West 33 St.
Chicago 16, Ill.

A prediction that banks will take over the accounting tasks of industrial firms, and become the financial hubs for them, was made in March by a Chicago researcher in electronics.

"With more effective use of data processing systems, banks could handle payroll, trust, routine debt payments and collection of a company's billings," Virgil Disney told the American Institute of Banking.

Disney is director of electronics research at Armour Research Foundation.

"The future challenge to banks is using their electronic equipment as accounting systems for industry and the public," he said.

For smaller banks, which may not be able to justify data processing equipment, Disney suggested that they invest in a facility and "pool" the use of it. "This is especially appropriate in unit banking states, such as Illinois," he noted.

Disney said banks could perform accounting functions for industrial companies at a lower cost to them.

"Although bank functions have become more widely accepted, and bank services have grown, the tremendous flow of paper is a burden to many tasks." For example, he cited the number of checks handled annually by banks has increased more than 500 per cent from 1940 to 1960, from 2.5 billion to 13 billion.

Commenting on this daily deluge of paper, he said there are two solutions to the problem:

1) Operational methods to reduce the paper flow and
2) Data processing systems which will quickly, accurately and efficiently handle checks and documents.

"Direct payment of bills, and automatic payroll depositing, will help decrease the total number of checks," he said.

Also, methods of handling inter-bank checks will be expedited by transferring magnetic tapes containing demand deposit information, instead of checks between banks;

and common business languages between machines will allow transfer of magnetic tapes between banks, thereby eliminating the need for intermediate forms of paper.

POWERFUL NEW PROGRAMMING AIDS ANNOUNCED FOR IBM 1401 COMPUTER

International Business Machines Corp.
Data Processing Division
White Plains, N.Y.

Users of one of the widely-accepted data processing systems -- the IBM 1401 -- will be able to get their computers "on the air" faster at far lower cost with three new programming systems announced in April by this company.

The three aids -- COBOL, Autocoder and an Input/Output Control System -- are powerful additions to a broad selection of advanced programming systems and routines already available to 1401 users. The new additions make the programming package for the 1401 a very comprehensive set of programming tools.

COBOL

The IBM 1401 COBOL programming system will enable the 1401 to generate its own internal "machine language" instructions from programs whose statements closely follow written English usage and syntax. By permitting 1401 programmers to communicate with the computer in familiar terms related to business operations, the 1401 COBOL system will free them from the use of detailed machine language codes. This can mean significant savings in programming time and cost for 1401 users.

COBOL (Common Business Oriented Language) is the result of work by the Conference on Data Systems Languages (CODASYL), a voluntary cooperative effort of various computer manufacturers and users under the sponsorship of the U.S. Department of Defense. COBOL programming systems are also being developed by IBM for other computers, including the IBM 705, 705 III, 709, 1410, 7070, 7080 and 7090.

Autocoder

Autocoder is a symbolic language of easily remembered operation codes and names or symbols. Data and instructions can be referred to by meaningful labels, such as "WHTX" for withholding tax in a payroll operation, rather than by specific 1401 core storage locations.

The IBM 1401 Autocoder programming system will automatically assemble a program written in Autocoder language, translate the coded symbols into instructions in 1401 machine language and assign locations within the computer's memory for both data and instructions. Autocoder includes a number of single commands, each of which can generate sequences of machine language instructions. Like other programming systems, it relieves the 1401 programmer of much time-consuming clerical work.

Input/Output Control System

The Input/Output Control System (IOCS) for the 1401 will provide programmers with instructions and generalized routines that automatically perform the various input/output operations of the computer. With IOCS, the 1401's input/output units can be programmed with only four commands -- "GET," "PUT," "OPEN" and "CLOSE". Since about forty per cent of the instructions in a typical machine-coded computer program are related to the machine's input/output operations, the IOCS can save considerable 1401 programming time and effort by efficiently scheduling these computer functions.

Availability

The 1401 COBOL system will be initially available in the first quarter of 1962 for 1401s with core storage capacities of 8,000, 12,000 or 16,000 characters. A version for 1401s with 4,000 positions of core memory will become available during the second quarter of 1962. A 1401 will also require certain other standard units, such as magnetic tape drives, and special features to be able to handle COBOL.

The 1401 Autocoder is now available.

The 1401 IOCS will be made available in the third quarter of 1961.

COBOL, other 1401 programming aids, Autocoder, and IOCS have been designed to match the capabilities of specific configurations of the 1401.

This package of programming aids for the 1401 represents many man-years of preparation and testing by IBM. Besides the three new systems, the aids range from pre-written routines, which perform many of the everyday operations of the 1401, to other highly-refined programming systems that provide various simplified languages to speed program writing. Most of the programs developed for the 1401 can be used without revision for the larger, more powerful IBM 1410 data pro-

cessing system. This programming compatibility permits ready systems expansion by firms with growing volumes and expanding computer needs.

The IBM 1401 is a small-to-medium-size computer available in a wide variety of configurations which can be tailored to individual user requirements. It has four basic models: punched card, magnetic tape, RAMAC and RAMAC/tape. With a monthly rental that starts below $2,500, the 1401 is bringing advanced data processing methods and numerous operating features previously found only in larger, more costly computers within the reach of many smaller firms.

PORTABLE MAGNETIC-TAPE DIGITAL RECORDING SYSTEM

Minneapolis Honeywell
Industrial Systems Div.
10721 Hanna St.
Beltsville, Md.

This company has developed a portable digital recording system which is designed for unattended data acquisition over long periods. It is completely transistorized. It is called the Type 6150 Incremental Digital Recording system. It acquires asynchronous data by a tape stepping method which is highly economical and dependable.

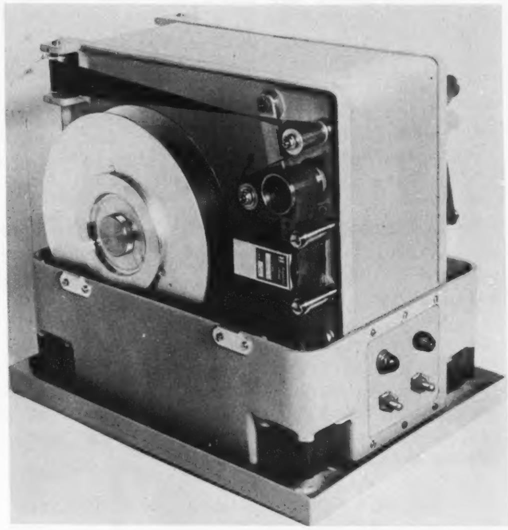
At a nominal stepping speed of 30 steps per second (200 steps per inch of tape), 38 hours of continuous recording are handled with one reel of tape. At lower sampling speeds, the tape supply from one reel often is adequate to permit unattended, automatic operation for a year or longer.

The recorder's power requirement is only 8 watts; therefore it can be operated with two standard 12-volt automobile batteries, if standard line power sources are not available.

The compact recorder incorporates integral shock mounts, and provides the mobility necessary for applications in seismology, geology, water level surveys, oceanography, and many other fields.

The new system records data with track widths and spacings compatible with most standard computers or data transcribing units. Its reels (NAB hub) are interchangeable with any laboratory-type tape-handling equipment.

The system can be arranged at the factory to operate with tape widths of 1/2, 3/4 or 1 inch. It also may be used for monitoring servo lines by incorporating a servo repeater and an encoder in a second housing.



CONVERTING ADDRESSOGRAPH PLATES TO COMPUTER LANGUAGE

Rabinow Engineering Co. Inc.
7212 New Hampshire Ave.
Washington 12, D.C.

This company has established a Service Department to handle conversion of Addressograph plate impressions to electronic data processing language. A Rabinow Universal Reader for automatically reading Addressograph plate impressions and simultaneously converting them to EDP language is now being assembled.

The machine is capable of handling all existing metal address plate fonts. It will read them electronically at a rate of six or more lines of print per second and then accurately code this information on any of the conventional EDP inputs such as punched paper tape, magnetic tape or punched cards. The speed capabilities of the RUR are such that a one-million name and address list can be converted in less than 150 machine hours, as compared to several months using other means of conversion. In addition, one time conversion costs will be reduced considerably through making use of time on the RUR at the Rabinow Service Department.

AIR TRAFFIC MILEAGE MANUAL PRODUCED BY COMPUTER

International Air Transport Association
1060 University St.
Montreal 3, Quebec, Canada

Starting April 1, one of the most important books in the airline industry has become a 420-page volume entirely written by an electronic data processing machine.

Published by the International Air Transport Association, it is used for computation of fares between 70,000 pairs of points on the world air network.

It represents the culmination of almost three years of preparatory work by a special IATA Computer Working Group. It is the first substantial step toward the possible eventual computation of all fares and rates by electronic means.

The IATA Mileage Manual gives airlines the shortest operated distances between selected pairs of 1,600 cities on the world airline map. While an almost infinite variety of routings between these points is possible, the lowest fares to be charged are controlled by the most direct routing, with certain allowable deviations for the actual itinerary. The Manual will now be the authoritative statement of these routings.

Preparation of the new Manual involved over 800,000,000 mileage calculations. If done by hand, the job would have required 1,000,000 man hours of computation, or a year's employment for 5,000 men.

As produced by electronic computer, the Manual has been turned out entirely by machine. Non-stop sectors flown by individual airlines were fed into an IBM 704 computer on magnetic tape. The machine then calculated the various combinations possible, selected the shortest routing applicable between each pair of points concerned, chose four intermediate points to indicate the routing and printed the result automatically on photo-offset master pages.

While 36 months were needed to organize the project and prepare the data for the computer, final computation and production of the 420 master pages took only 30 hours. To calculate all reasonable routings from any one city in the tables to all the rest and select the shortest operated mileages takes 12 seconds.

The new Manual has revealed the fact that there are now more than 4,000 non-stop flight sectors operated by IATA airlines and other air carriers. The longest listed is 4,692 miles, between Anchorage and Paris; the shortest, 13 miles between Kamalpur and Khowai in India.

According to J. E. McGuire, Pan American World Airways, Chairman of the 11-man IATA Computer Group, the new Manual has additional significance as the airline industry's first cooperative effort to produce the raw material for routing.

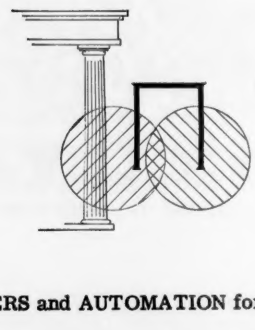
With the blessing of the IATA Traffic Conferences, the Group is now evaluating a Model Trial Fares Table based on routings via the mid-Atlantic, which it is hoped will be the pilot project for possible worldwide electronic fares tables.

Actual calculation of the mileages was carried out on IATA's behalf by the industrial research firm of Arthur D. Little, Inc., Cambridge, Mass., under the direction of Dr. Arthur A. Brown. A trial first edition was issued for Conference review.

Describing the complexity of the job, Dr. Brown points out that the number of all reasonably possible routings between the 1,600 cities concerned "is so large that you couldn't write it down within the solar system". However, the research team found a way to make the computer take the best routing choice at each stop, and so reduced the job to manageable proportions.

Information now contained in the Manual is stored away on 10,000 feet of magnetic tape which can be re-run for additional computations. The Manual itself will be kept up-to-date on a biennial publication schedule, and is available to outside parties at $100 per copy. Tape and punched card versions are also available at cost.

Chairmen of the Computer Group during the three-year preparation, in addition to Mr. McGuire, have been L. H. Bateman of British Overseas Airways Corporation and C. Hunderup of Scandinavian Airlines System.



MAGNETIC CARD RANDOM ACCESS MEMORY

National Cash Register Co.
Dayton 9, Ohio

A "new generation" memory file for use with the new NCR 315 electronic data processing system has been announced by this company.

Called Card Random Access Memory (CRAM), the unique device employs a removable cartridge containing 256 magnetic cards on which information can be stored in any order and selected and read when required in a sixth of a second.

The system is designed to provide more economical access to large volumes of information than any similar device now available. CRAM also makes it possible to store, sort, update, and report through use of a single magnetic file.

The new unit's high-speed accessibility and its large-capacity storage appear to furnish a new concept in low-cost processing techniques. As a result, data are available to business management faster and over-all processing is more efficient.

In a department store application, for example, CRAM provides immediate information regarding merchandise in stock; in a bank the balance on a loan or checking account; in a manufacturing concern a quick report on the availability of materials to meet accelerated production requirements.

In addition to supplying management information faster, the magnetic card memory also introduces new techniques and efficiency in the processing of data.

For example, random processing of business transactions eliminates the time required to sort items into sequential order prior to posting. A "deck" of the magnetic cards can be divided into several parts, such as master file, customer account file or inventory file; and a single magnetic card memory unit can be used to sort transactions into sequence, an operation which normally requires several conventional reel-type units.

The cards used with CRAM are plastic, 14 inches long and 3¼ inches wide. They are suspended from 8 two-position rods in a removable cartridge. Each cartridge contains 256 cards. The entire cartridge can be replaced with another in approximately 15 seconds.

In operation, the two-position rods turn in such a combination that the selected card is released onto a rotating drum where it is read or written on at a rate of 100,000 alpha-numeric characters a second.

Information is magnetically recorded on one of seven vertical tracks on the card. The computer also selects the recording track for reading or writing data. Information can be read or written on any track prior to the card's return to the cartridge.

Each magnetic card can store 21,700 alpha-numeric characters or 32,550 decimal digits of information, providing a storage capacity of over 5.5 million alpha-numeric characters or 8.3 million digits in a single cartridge. This capacity is equivalent to the one-million seven-digit telephone numbers listed for the entire city of Los Angeles.

Up to 16 CRAM units can be operated in a 315 computer system. In addition to the CRAM units, the 315 computer can also control up to

eight high-performance, multi-speed, magnetic tape units. Cartridges of magnetic cards are interchangeable between CRAM units in much the same way that reels of tape can be interchanged.

One of the significant features of the new memory file, the company said, is its ability to store or transfer data in either a random or sequential manner.

In random storage, access time is extremely fast and any card can be selected in 170 milliseconds. Re-access of a card already in the write-read station is only 14 milliseconds. Further speed can be achieved by "time-sharing", which enables the next card to be selected while processing is being completed on the card currently in the write-read position. Also, all CRAM units can be selecting cards at the same time.

When used as a sequential storage medium, one magnetic card unit can efficiently perform difficult sorting tasks. A full sort with two-way merge capabilities can be performed for up to 69,440 ten-word items on a single CRAM unit. To carry out this same operation efficiently on reel-type magnetic tape would require four units.

CRAM also offers complete freedom of choice of file maintenance, such as sequentially updating the old file by creating an entirely new master file, and purely-random posting of transactions. Several techniques have been developed which use the best features of both random and sequential file posting techniques.

The new memory unit for the advanced solid-state NCR 315 electronics data processing system is priced at $38,000, or it can be rented for approximately $950 a month, NCR announced. No external control units are required. CRAM will be available with the delivery of the first NCR 315 computer systems, scheduled for early 1962.

COMPUTERS ANALYZE JET FUEL BIDS; $5 MILLION ANNUAL SAVINGS EXPECTED

U.S. Dept. of Defense
Washington 25, D.C.

A Navy-devised system using computers to analyze the bids of companies competing to sell jet fuel to the Department of Defense is expected to save $5 million of the annual $400 million cost of the fuel.

The new automatic data processing system took less than a day to process bids to the Military Petroleum Supply Agency for six months' supply of jet fuel, two billion gallons, costing about $200 million. MPSA is the single manager under Navy direction for procurement, distribution and standardization of petroleum products for the Department of Defense.

Developed by mathematicians and operations research analysts of the Navy Management Office and MPSA, the system represents a breakthrough in the solution of management problems of this magnitude, accomplished with use of modern mathematics and fast computers.

A high-speed digital computer was given a giant puzzle involving over 500 complex, interrelated bids from 95 oil companies. It also considered the needs of 300 military users, legal restrictions, physical conditions, and the shipping routes from each bidder to each destination. The computer must, itself, find and evaluate routes from an almost infinite number of possibilities.

The puzzle, in fact, has many possible cheap solutions, but it is required to find the cheapest possible solution. Yet, the small amount of data fed into the machine and the solution obtained are in nontechnical, nonmathematical terms. Without human intervention, the system performs over 500 million calculations and produces a procurement and distribution plan which is the cheapest possible to the Government yet meeting the requirements.

The computer used in the contract awards, having generated and solved a set of mathematical equations, printed out reports which showed the awards to be made, the base to which each batch of fuel was to be shipped and the exact shipping routes, including all transfer points and methods of shipment.

Before the new system was put into use, it underwent extensive tests. These disclosed that savings of one and one-quarter percent over the traditional methods of analyzing bids could be expected, in the cost of procurement and transportation of fuel. The fact that the percentage of savings was not greater is a tribute to the methods previously used by MPSA, but since MPSA now procures over 400 million dollars' worth of jet fuel alone each year, the one and one-quarter percent savings, amounting to 5 million dollars a year, demonstrate the results that can be obtained by applying modern mathematics in large-scale management problems.

WHO'S WHO IN THE COMPUTER FIELD

From time to time we bring up to date our "Who's Who in the Computer Field." We are currently asking all computer people to fill in the following Who's Who Entry Form, and send it to us for their free listing in the Who's Who that we publish from time to time in **Computers and Automation.** We are often asked questions about computer people—and if we have up to date information in our file, we can answer those questions.

If you are interested in the computer field, please fill in and send us the following Who's Who Entry Form (to avoid tearing the magazine, the form may be copied on any piece of paper).

Name? (please print).......................

Your Address? ....

Your Organization? ....

Its Address? ....

Your Title? ....

Your Main Computer Interests?

( ) Applications
( ) Business
( ) Construction
( ) Design
( ) Electronics
( ) Logic
( ) Mathematics
( ) Programming
( ) Sales
( ) Other (specify):

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Year of birth? ....

College or last school? ....

Year entered the computer field?....

Occupation? ....

Anything else? (publications, distinctions, etc.) ....

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When you have filled in this entry form please send it to: Who's Who Editor, **Computers and Automation,** 815 Washington Street, Newtonville 60, Mass.

CALENDAR OF COMING EVENTS

May 2-4, 1961: Electronic Components Conference, Jack Tar Hotel, San Francisco, Calif.

May 7-8, 1961: 5th Midwest Symposium on Circuit Theory, Univ. of Ill., Urbana, Ill.; contact Prof. M. E. Van Valkenburg, Dept. EE, Univ. of Illinois, Urbana, Ill.

May 8-10, 1961: 13th Annual National Aerospace Electronics Conference, Biltmore and Miami Hotels, Dayton, Ohio; contact Ronald G. Stimmel, Chairman, Papers Committee, Institute of Radio Engineers, 1 East 79 St., New York 21, N. Y.

May 9-11, 1961: Western Joint Computer Conference, Ambassador Hotel, Los Angeles, Calif.; contact Dr. W. F. Bauer, Ramo-Wooldridge Co., 8433 Fallbrook Ave., Canoga Park, Calif.

May 22-24, 1961: 10th National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24, 1961: Fifth National Symposium on Global Communications (GLOBECOM V), Hotel Sherman, Chicago, Ill.; contact Donald C. Campbell, Tech. Program Comm., I.T.T.—Kellogg, 5959 S. Harlem Ave., Chicago 38, Ill.

May 23-25, 1961: Symposium on Large Capacity Memory Techniques for Computing Systems, Dept. of Interior Auditorium, C St., Washington, D. C.; contact Miss Josephine Leno, Code 430A, Office of Naval Research, Washington 25, D. C.

June 6-8, 1961: ISA Summer Instrument-Automation Conference & Exhibit, Royal York Hotel and Queen Elizabeth Hall, Toronto, Ontario, Can.; contact William H. Kushnick, Exec. Dir., ISA, 313 6th Ave., Pittsburgh 22, Pa.

June 28-30, 1961: Joint Automatic Control Conference, Univ. of Colorado, Boulder, Colo.; contact Dr. Robert Kramer, Elec. Sys. Lab., M.I.T., Cambridge 39, Mass.

June 28-30, 1961: 1961 National Conference and Exhibit, National Machine Accountants Association, Royal York Hotel, Toronto, Canada; contact R. C. Elliott, NMAA, 1750 W. Central Rd., Mt. Prospect, Ill.

July 9-14, 1961: 4th International Conference on Bio-Medical Electronics & 14th Conference on Elec. Tech. in Med. & Bio., Waldorf Hotel, New York, N. Y.; contact Herman Schwan, Univ. of Pa., School of EE, Philadelphia, Pa.

July 16-21, 1961: 4th International Conf. on Medical Electronics & 14th Conf. on Elec. Tech. in Med. & Bio., Waldorf Astoria Hotel, New York, N. Y.; contact Dr. Herman P. Schwan, Univ. of Pa., Moore School of Electrical Eng., Philadelphia 4, Pa.

July 21-22, 1961: 1961 Northwest Computing Association Annual Conference, Univ. of British Columbia, Vancouver, British Columbia, Can.; contact Conference Information, Northwest Computing Assoc., Box 836, Seahurst, Wash.

Aug. 22-25, 1961: WESCON, San Francisco, Calif.; contact Business Mgr., WESCON, 1435 La Cienega Blvd., Los Angeles, Calif.

Sept., 1961: Symposium on Information Theory, M.I.T., Cambridge, Mass.

Sept. 4-9, 1961: Third International Conference on Analog Computation, organized by the International Association for Analog Computation and the Yugoslav National Committee for Electronics, Telecommunications, Automation and Nuclear Engineering, Belgrade, Yugoslavia.

Sept. 6-8, 1961: National Symposium on Space Elec. & Telemetry, Albuquerque, N. M.; contact Dr. B. L. Basore, 2405 Parsifal, N.E., Albuquerque, N. M.

Sept. 6-8, 1961: 1961 Annual Meeting of the Association for Computing Machinery, Statler Hotel, Los Angeles, Calif., contact Benjamin Handy, Chairman, Local Arrangements Committee, Litton Industries, Inc., 11728 W. Olympic Blvd., W. Los Angeles, Calif.

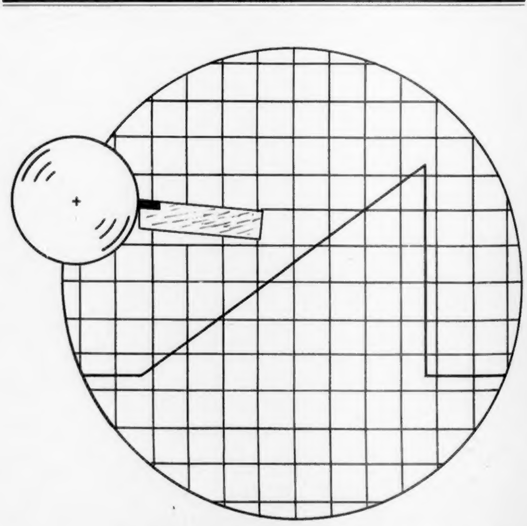
Sept. 11-15, 1961: The Third International Congress on Cybernetics, Namur, Belgium; contact Secretariat of The International Association for Cybernetics, 13, rue Basse Marcelle, Namur, Belgium.

Sept. 11-15, 1961: ISA Fall Instrument-Automation Conference & Exhibit and ISA's 16th Annual Meeting, The Biltmore Hotel and Memorial Sports Arena, Los Angeles, Calif.; contact William H. Kushnick, Exec. Dir., ISA, 313 6th Ave., Pittsburgh 22, Pa.

Oct., 1961: National Symposium on Space Elec. & Telemetry, Albuquerque, N. M.; contact A. B. Church, 1504 Princeton, S.E., Albuquerque, N. M.

Oct. 25-26, 1961: 1961 Computer Applications Symposium, Morrison Hotel, Chicago, Ill.; contact Benjamin Mittman, conf. program chmn., Armour Research Foundation, 10 W. 35 St., Chicago 16, Ill.

Dec. 12-14, 1961: Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.; contact Jack Moshman, C-E-I-R, Inc., 1200 Jefferson Davis Highway, Arlington 2, Va.



BOOKS AND OTHER PUBLICATIONS

Moses M. Berlin
Allston, Mass.

We publish here citations and brief reviews of books and other publications which have a significant relation to computers, data processing, and automation, and which have come to our attention. We shall be glad to report other information in future lists if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / comments. If you write to a publisher or issuer, we would appreciate your mentioning **Computers and Automation.**

Whitesitt, J. Eldon / Boolean Algebra and its Applications / Addison-Wesley Pub. Co., Inc., Reading, Mass. / 1961, printed, 182 pp, $6.75.

This book offers an excellent introduction to Boolean algebra and its applications, and is aimed at the reader with a limited mathematical background. The author, Associate Professor of Mathematics, Montana State College, covers in seven chapters: The Algebra of Sets, Boolean Algebra, Symbolic Logic and the Algebra of Propositions, Switching Algebra, Relay Circuits and Control Problems, Circuits for Arithmetic Computation, and Introduction to Probability in Finite Sample Spaces. Answers to problems, which are found in each section, and an index are included.

Howard W. Sams Engineering Staff / Transistor Substitution Handbook / Howard W. Sams & Co., Inc., and The Bobbs-Merrill Co., Inc., Indianapolis and New York / 1961, printed, 95 pp, $1.50.

Following a brief discussion of the reasons for making transistor substitutions, this book presents a table giving more than 6500 "direct substitutions," instances where it is possible to replace one transistor type with others. Included are substitutes for transistors manufactured in the U. S., England, France, Germany, The Netherlands, Italy and Australia. A separate table lists substitutes for 668 Japanese types.

Lytel, Allan / ABC's of Computers / Howard W. Sams & Co., Inc., and The Bobbs-Merrill Co., Inc., Indianapolis and New York / 1961, printed, 128 pp, $1.95.

This booklet is a basic introduction to the theory and applications of computers. In twelve chapters, the author discusses: Computers—Digital and Analog, Solid-State Circuit Devices, Symbolic Logic, Basic Logical Circuits, Information Storage, Input-Output Devices, Programming, etc. The book is written for the electronic technician whose background includes basic mathematics, and for non-technical people with similar backgrounds.

Notre Dame Journal of Formal Logic / University of Notre Dame Press, Notre Dame, Indiana / printed, $6.00 (per year).

This new quarterly will treat subjects in symbolic logic and its applications to metalogic, semantics and mathematics. The Jan., 1960 (vol. 1, nos. 1-2) edition includes the following papers: An Extension Algebra and the Modal System, Investigations on a Comprehension Axiom Without Negation in the Defining Propositional Functions, Studies in the Axiomatic Foundations of Boolean Algebra, part 1, Independence of Faris-rejection-axioms, On the Single Axioms of Protothetic, and Independence of Tarski's Law in Henkin's Propositional Fragments.

Evans, W. H. / Experiments in Electronics / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1959, printed, 374 pp, $9.00 ($6.75 for classroom text edition).

Two experiments for each of fifty topics are presented. The experiments stress essential theory and in most cases require equipment usually available in the laboratory. The author, Professor of Electrical Engineering, University of Arizona, treats space charges, vacuum tubes and transistors, rectifiers, regulators, amplifiers, feedback, blocking oscillators, clamping circuits, etc. An appendix discusses the characteristics of transistors and vacuum tubes.

Johnson, Charles H., Editor / Data Processing, 1960 Proceedings / National Machine Accountants Assn., 1750 West Central Rd., Mt. Prospect, Ill. / 1960, printed, 255 pp, $10.00.

Twenty-nine papers delivered at the NMAA 1960 conference are published. The two main categories are "General Interest" and "Automated Input." Following are some titles: Auditing the Data Processing System, Writing Effective Reports, Managing a Computer Center Seminar, Optical Character Sensing for Life Insurance Premium Billing, The IBM 1401 Data Processing System, and Business Applications for Small Computers—Burroughs E101. Some of the papers are in discussion form, e.g., NMAA National Education Program.

Wozencraft, John M., and Barney Reiffen / Sequential Decoding / The Technology Press, Mass. Inst. of Technology, Cambridge, Mass. and John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1961, printed, 74 pp, $3.75.

This monograph considers the problems of coding and decoding in electrical communication work, from a probabilistic point of view. The "sequential decoding" procedure and its applications are described in detail. In addition to the chapter on the procedure, five chapters discuss: Coding and Communication, Block Codes, Convolutional Encoding, Simulation, and Extensions and Applications. An appendix covers "Bounds on Sums of Random Variables." Dr. Wozencraft is an Associate Professor of Electrical Engineering at M.I.T., and Dr. Reiffen is Lecturer in Electrical Engineering at M.I.T. and a staff member of Lincoln Laboratory. References.

Symposium on Superconductive Techniques for Computing Systems, PB 161763 / U. S. Dept. of Commerce, Washington 25, D. C. / 1960, offset, 413 pp, $4.50.

The proceedings of this Symposium held in May, 1960, contain thirty-three papers on the application of cryogenic techniques to information processing devices and systems. The papers cover the general state of cryogenic research and the research itself; including, for instance, "Research on Superconductive Devices in Sweden" and "Characteristics of Bulk and Thin Film Superconducting Alloys."

Howe, R. M. / Design Fundamentals of Analog Computer Components / D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. / 1961, printed, 268 pp, $7.50.

This book is written for those with a working knowledge of analog computing techniques and provides information on the detailed design of analog components and the effect of component errors on the problems solved by the computer. The author is Professor of Aeronautical and Astronautical Engineering, University of Michigan. Author and subject indices.

Robertson, Struan A. / Engineering Management / Philosophical Library, Inc., 15 East 40 St., New York 16, N. Y. / 1961, printed, 467 pp, $10.00.

The "art of management" is presented for the engineer as an indispensable part of his education. The text, which forms the basis for a course at Battersea Polytechnic University, London, Eng., consists of three sections: The Art of Management, The Science of Management, and The Practice of Management. The scope of the art, scientific methods for its implementation, and the planning, organizing and handling of management decisions are discussed. Conclusions, which analyze "day-to-day management," management problems and an index are included.

Stanton, Ralph G. / Numerical Methods for Science and Engineering / Prentice-Hall, Inc., Englewood Cliffs, N. J. / 1961, printed, 266 pp, $9.00.

This introduction to numerical analysis emphasizes basic problem-solving techniques, written for use by engineering undergraduates. The author, Professor of Mathematics and Chairman of the Dept., University of Waterloo, Ontario, Canada, includes discussion of ordinary finite differences, computation with series and integrals, linear systems and matrices, and the principles of automatic computation. Selected bibliography and index.

Fano, Robert M. / Transmission of Information: A Statistical Theory of Communications / The Technology Press, Mass. Inst. of Technology, Cambridge, Mass., and John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1961, printed, 389 pp, $7.50.

The foundations and many of the applications and results of information theory are presented. Nine chapters discuss the formulations and mathematical techniques that have proved to be of greatest significance to the communications engineer. The book, written by one of the earliest workers in information theory, and a Professor of Electrical Communications at M.I.T., is aimed primarily at engineers and graduate students in the field. Three appendices include problems, entropy tables, and a table of the Gaussian Distribution Function. Index.

Siff, Elliot J., and Claude L. Emmerich / An Engineering Approach to Gyroscopic Instruments / Robert Speller & Sons, Inc., 33 West 42 St., New York 36, N. Y. / 1961, printed, 120 pp, $7.50.

The fundamentals of gyroscopics and the design of precision gyroscopic instru-

ments are presented for the engineer in a manner which aims to give (1) an intuitive feel, and (2) sufficient mathematical grasp. E. J. Siff is Head of Advanced Research, Kearfott Division, General Precision, Inc.; C. L. Emmerich is Head of Stabilization and Navigation Branch, Norden Division, United Aircraft Corp. In the first three chapters, basic and special gyroscopic design and configuration are presented, while the final chapter discusses applications. A glossary, bibliography and an index are included.

Buffa, Elwood S. / Modern Production Management / John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. / 1961, printed, 636 pp, $10.25.

A classroom text introducing the management and economics of production, this book combines traditional viewpoints with recent analytical methods. The author, Associate Professor of Production Management, University of California, divides the subject matter into four parts: (1) Introduction, including a review of production management and information on the production function; (2) Analytical Methods in Production Management; (3) Design of Production Systems, with a section on computers and automation; (4) Operation and Control of Production Systems. Two appendices discuss "The Modified Distribution Method of Linear Programming" and "Simplex Solution." Index.

Mikulich, R. C., Editor / Test of a Model Dynamic System Synthesizer, PB 171144 / Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. / 1960, mimeographed, 165 pp, $3.00 (free to qualified requesters from: Armed Services Technical Information Agency, Arlington Hall Station, Arlington 12, Va.).

This report is part of a study, by the University of Chicago for the Air Force, to develop a theory of the effects of the non-ideality of analog computer elements and a program to test analog computers. Some results of applying the test program to an RCA experimental analog computer is the subject of this publication. A comprehensive analysis of the components, a detailed description of the tests, and a discussion of results are included in the report. Four chapters and bibliography.

Smullyan, Raymond M. / Theory of Formal Systems / Princeton University Press, Princeton, N. J. / 1961, offset, 142 pp, $3.00.

Number 47 in the Annals of Mathematics series, the book presents an introduction to recursive function theory and some new results in this field. It is written for the mature mathematician with no background in mathematical logic. The five chapters are: Formal Systems, Formal Representability and Recursive Enumerability, Incompleteness and Undecidability, Recursive Function Theory, Creativity and Effective Inseparability. A supplement discusses ten additional topics. References and bibliography.

Computer Abstracts / Technical Information Co., Ltd., Chancery House, Chancery Lane, London, W. C. 2, Eng. / 1960, printed, $96.00 per annum.

More than 5000 references a year are annotated and systematically classified. Over 600 scientific, technical, and business publications are regularly examined. Every month some 8500 British, German, U. S., and Russian patents are scanned. The Nov., 1960, issue (vol. 4, no. 11, 16 pp) contains 212 abstracts of articles on topics related to computers and data processing. The abstracts are categorized, e.g., Design, Mathematical, Digital, Programming, etc.; an author index and a patent index are given.

SURVEY OF RECENT ARTICLES

Moses M. Berlin
Allston, Mass.

We publish here a survey of articles related to computers and data processors, and their applications and implications, occurring in certain magazines.

The purpose of this type of reference information is to help anybody interested in computers find articles of particular relation to this field in these magazines.

For each article, we publish: the title of the article / the name of the author (s) / the magazine and issue where it appears / the publisher's name and address / two or three sentences telling what the article is about.

A Computer-Controlled Multi-Channel Blending System / Automatic Control, vol. 13, no. 6, Dec., 1960, p 26 / Reinhold Pub. Corp., 430 Park Ave., New York 22, N. Y.

A technique for applying a computer to the control of a petroleum blending operation is reported. The Bendix G-15 computer receives as input, meter and valve calibrations and blend composition data; it then computes operating points for the equipment, and controls the flow of various ingredients. The technique is applicable in chemical and missile propellant operations.

Discontinuous Control Stops Train Accurately / Toshihiko Ito, Japanese National Railways / Control Engineering, vol. 8, no. 1, Jan., 1961, p 90 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N. Y.

This article describes an automatic braking apparatus developed in Japan, which provides remote control braking of railroad cars to within four inches of a desired stopping point. Techniques used in the development of the apparatus, including piecewise optimum nonlinear control, are discussed. The results of test runs are given.

Logical Synthesis Plus Breadboarding Yields Gray Code Counter / Harry W. Mergler, Case Institute of Technology / Control Engineering, vol. 8, no. 1, Jan., 1961, p 99 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N. Y.

The article discusses "quantitative synthesis procedures" to design typical scaling logic, and to test the efficacy of a system before it is built. A description is given of an application of the procedure, in which a breadboard constructed with commercial logic modules, is checked for errors.

Can Our Free Economy Meet the Threat of Soviet Automation? / John Johnston, Jr., E. I. du Pont de Nemours & Co., Inc., / ISA Journal, vol. 7, no. 12, Dec. 1960, p 58 / Instruments Society of America, 313 Sixth Ave., Pittsburgh 22, Penna.

The status of Soviet automation is discussed, including specific information on the status of research and development in various Russian cities. The general conclusion, that automation is considered essential to economic growth in Russia, and that its implementation is becoming widespread, is demonstrated. The article concludes with an admonition to the U. S. to bolster its automation efforts.

Tailoring Flow Measurement to Computer Control / James H. Kogen, GPE Controls, Inc., Chicago, Ill. / ISA Journal, vol. 7, no. 12, Dec., 1960, p 41 / Instruments Society of America, 313 Sixth Ave., Pittsburgh 22, Penna.

Techniques which allow for maximum use of a computer's capabilities in process control are described. These techniques are explained in a discussion of the use of a computer to regulate the flow of fluids and to control their mixture. Instrumentation which is used in conjunction with the computer, and economical applications of the technique, are discussed.

Magnetic Tape Recording / Paul J. Weber, Ampex Data Prods. Co. / ISA Journal, vol. 7, no. 12, Dec., 1960, p 31 / Instruments Society of America, 313 Sixth Ave., Pittsburgh 22, Penna.

The principles of various forms of magnetic tape recording including: analog frequency modulation, analog direct, pulse duration modulation, and digital recording, are explained. In each case, the text is supplemented by diagrams. A brief description of the magnetic tape unit, including the hardware, is given.

Unique Plotting System Turns Digits into Curves / Mitchell Bain and Robert N. Flanders / Control Engineering, vol. 8, no. 1, Jan., 1961, p 111 / McGraw-Hill Pub. Co., Inc., 330 West 42 St., New York 36, N. Y.

This article describes a program for the plotting of digital computer results on standard X-Y or strip chart recorders when these results are sufficiently voluminous to justify the preparation of special format magnetic tapes. The program makes use of the subroutines used in preparing the special format plotter tapes, and is thereby simple, efficient, and gives the programmer control over the plotting.

What You Should Know About Computers / W. Paul Gilpin, Associate Editor / Modern Office Procedures, vol. 6, no. 3, Mar., 1961, p 16 / Industrial Pub. Corp., 812 Huron Rd., Cleveland 15, Ohio.

"You are dead wrong if your idea of a computer is . . . a monster with nervously twitching dials . . ." This article proceeds to explain in detail the true nature of the computer, how it is used, on what basis it is applied, and what the future holds for its development and application. Accompanying the well documented text are: a chart listing the specifications of more than fifty computers, and a glossary of computer terms.

Computer Control in an Oil Refinery / Computer News, vol. 4, no. 11, Nov., 1960, p 5 / Technical Information Co., Ltd., Chancery House, Chancery Lane, London, W. C. 2, Eng.

The use of an IBM 704 computer to control the operation of a large petroleum refinery is discussed. The research which led to this application, and the functioning of the system from initial input to eventual control, are described. A flow diagram of the system accompanies the text.

Circuit Blocks Aid Initial Design / G. A. Clark / Automatic Progress, vol. 5, no. 12, Dec., 1960, p 405 / Leonard Hill Technical Group, Leonard Hill House, Eden St., London, N. W. 1, Eng.

Logical elements which will facilitate the design of computer circuitry are described. This one-page article describes the elements, AND, OR, DELAY, PULSE SHAPER, etc.; and provides illustrations of their use. A diagram which illustrates an application of an element accompanies the text.

Driverless Trucks Speed the Goods / Automation Progress, vol. 5, no. 12, Dec., 1960, p 395 / Leonard Hill Technical Group, Leonard Hill House, Eden St., London, N. W. 1, Eng.

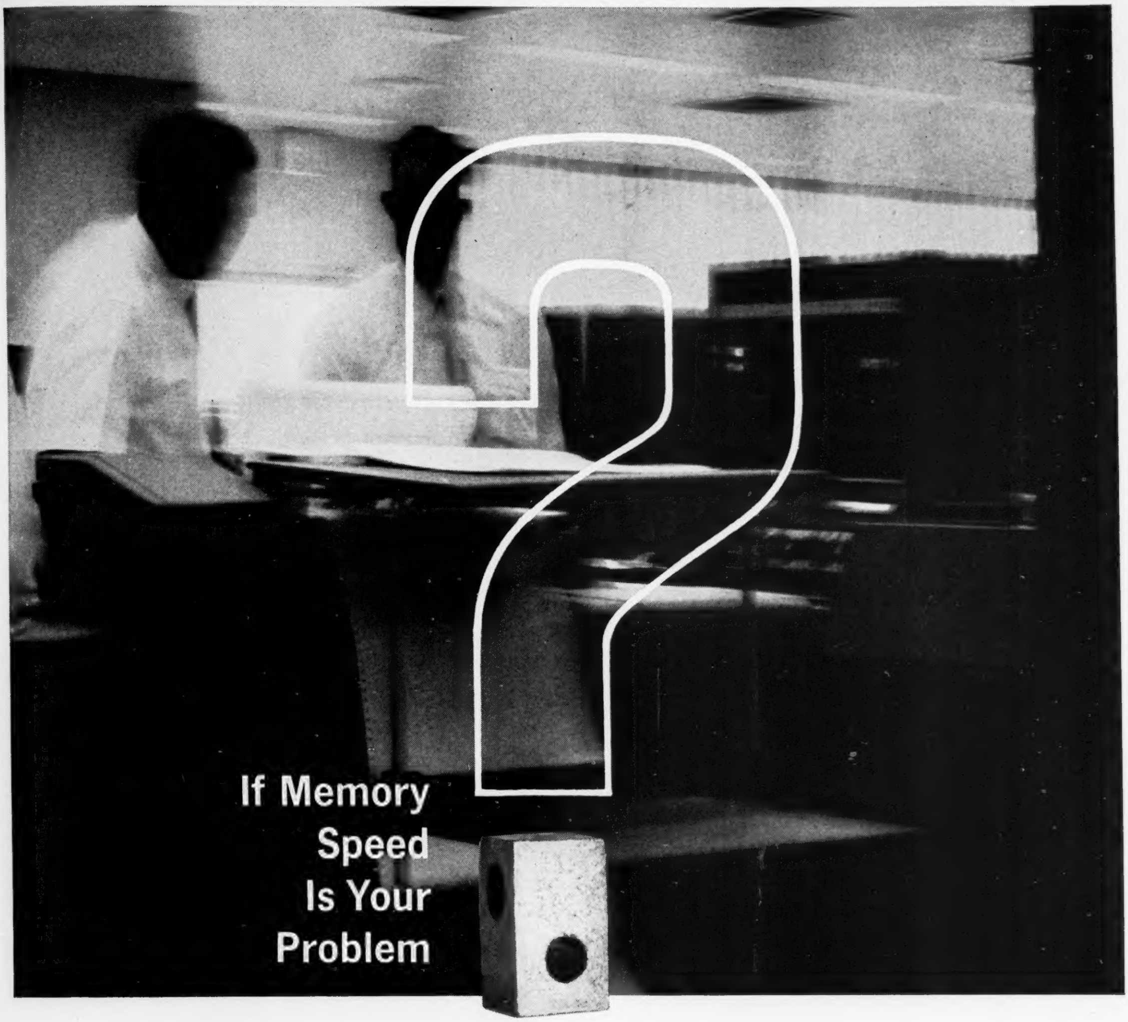
The use by British Railways of five "Robotug" driverless trucks is described. The automatic tugs contain built-in electronic machines programmed to control their trips at 2 miles per hour along fixed routes, using a guide wire carrying 1/6 amp. a.c. laid ½ inch below the surface. The safety and economy of the systems are discussed.

The Effect of Electronic Data Processing on Audit Procedures / Lansdale Boardman / Systems & Procedures, vol. 12, no. 1, Jan.-Feb., 1961, p 29 / Systems & Procedures Assn., 817 Penobscot Bldg., Detroit 26, Mich.

This article concentrates as much on the effect of the computer on the auditor, as it does on the relationship between data processing and auditing. When bookkeeping is done on machines, special problems arise for the auditor, who checks the "books." Mr. Boardman explains these problems and their solutions. The computers themselves can be utilized to help the auditor.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.



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